Concrete

Vol. 37 Chicago, August, 1930 No. 2

Damming, Blowing and Sealing in Crib House Construction

Extension of Intake Terminus on $15,000,000 Power Project Involved Placing Concrete in 25 Ft. of Water—Use of Tremie in Cramped Quarters—How the Tremie Was Sealed—Stopping a Leak Under High Pressure Head

By CHARLES C. MOODY[1]

MANY articles may have been written on the subject of tremie sealing, but it has never been my good fortune to read any. The knowledge I gained in order to do the work here described was by hearsay and through experimenting with various methods. It should be of special interest to the readers of CONCRETE, therefore, to have this description of an experience gained while on a large power house construction job just completed in the central part of Illinois.

Intake Terminus Extended

The portion of the work described in this article had to do with the crib house, or tunnel terminus, for the water intake.

The new crib house site lay as an extension to one of smaller capacity which was built a few years ago.

The fact that this new crib house was to be an extension of the old one made it a little more difficult than a wholly separate structure would have been, because, whereas the foundations for the original building had been sunk by dredging out the center of the building until they had reached the proper depth, the new building had to be connected to the old one by means of reinforcing steel dowels.

As shown in Figure 1, the new position is approximately 90 ft. long by 70 ft. wide. It is situated on the bank of a small artificial lake, that had formerly been a gravel pit, which was connected to the Illinois river by means of a dredged channel. The underlying soil was mostly sand, although some small gravel the size of a baseball was occasionally found and it was utilized for the concrete work throughout the entire job.

Preparation of Site

Because of the fact that the ground surface sloped from the water about one to one, a clamshell was used to cut down the high portion of this slope. This material was utilized to fill in along the lake just outside the cofferdam. Upon completion of this grading the site of the new addition was apparently quite level.

Preparations for driving the steel piling to enclose the cofferdam were then begun. A heavy wood frame, securely bolted together, was placed inside the cofferdam and laid flat on the ground. Another was laid along one side. These frames acted as a guide for the sheet piling as it was driven. Another frame was then standing up on the ones below and approximately fifteen feet above them, leaving a slot between for the sheets.

Driving

Driving was then started, with 14-in. interlocking steel shafts fifty feet in length. In order that these sheets might go down straight into the ground the first one was driven but 10 ft. down. Then another sheet was started and driven 8 ft. down, another 6 ft., and another 4 ft. and another 2 ft. Then the hammer was started again on the first, driving it 2 ft. more, then 2 ft. on the second, then 2 ft. on the third, and so on until the last one was reached. In this way the sheets went down simultaneously instead of separately and were guided as a whole.

Placing the Rangers

The old method of building a cofferdam was disregarded here. Where heretofore several sets of rangers and walers usually are used, in this instance only one was needed. It was of sufficient strength to withstand the tremendous pressure toward the center of the hole.

There was but one method to be used in order to do this. Twenty-one inch I-beams were driven into the ground 4 in. inside the steel sheets and spaced about 12 in. apart. These I-beams, however, did not go to rock, but were driven sufficiently deep below the elevation of the bottom of the hole to give them a sufficient toe hold.

Rock was at approximate elevation of 400. Lake level at the time the cofferdam was being constructed was about elevation 436. The top of the 21-in. I-beams was at elevation 440, and then completed excavation was at 413. The top of the rangers was about 435 and the grade of the ground surrounding the site was approximately 450. It will therefore be seen that the rangers were placed with the idea of taking about two-thirds of the load between the top and bottom of the excavated hole.

These rangers were divided into two groups, three of

---

[1] Member of firm of M. & W. Construction Co., Chicago, Ill.; formerly supervising engineer, The J. B. French Co., Chicago, Ill.

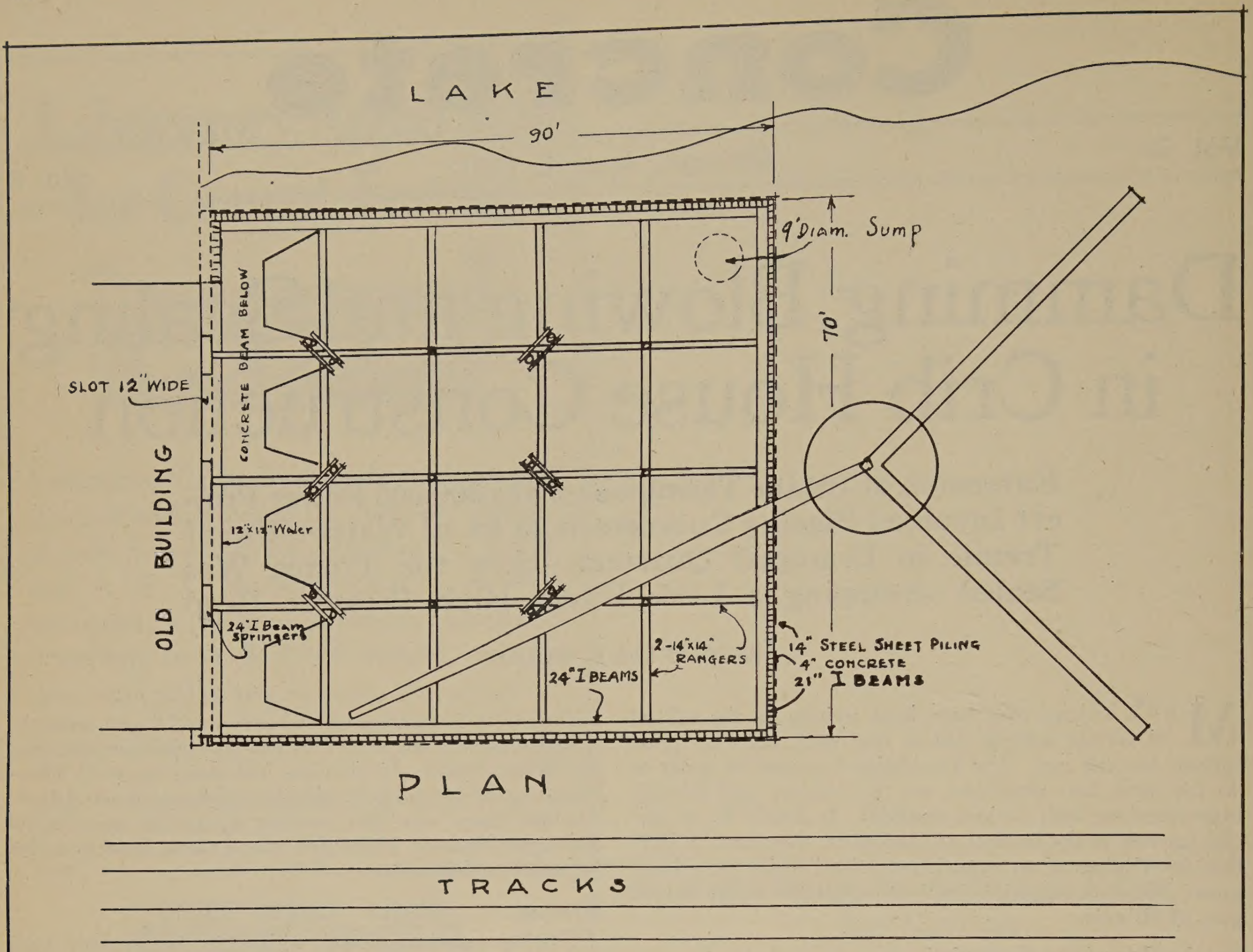


FIGURE 1

which ran longitudinally and five transversely across the hole. Each was made up of two 14 by 14-in. timbers, one on top and bolted to the one under it. At their intersections two wood piles were driven and 3 by 12-in. pieces were used as supports, to prevent deflection both above and below the rangers. These were bolted securely to the wood piles. Two 24-in. I-beams were used as walers to take the thrust of the rangers which were bolted to the vertical I-beams. An oak 4-by-4 near the top of the vertical I-beams kept them separated from the sheet piling. Steel wedges were driven between the walers and vertical I-beams and everything made tight.

The above description applies to the three sides of the cofferdam, but not the side adjacent to the old building. On this side the thrust of the longitudinal rangers was taken up by short I-beams placed horizontally against the concrete foundation, while the top of sheet piling along this end was cut off at approximate elevation 433. An independent 12 by 12-in. waler supported the top of this piling and was in turn bolted to the longitudinal rangers.

Sealing the Excavation with Concrete

The material inside the confines of the sheet piling was taken out by means of a clamshell bucket and was deposited in dump cars for use in concrete work elsewhere. The excavation, however, had to be carried on in spasms, taking out the material to the depth of eight feet and then stopping in order to seal the space between the I-beams and steel sheet piling with concrete.

The entire area was excavated to a grade of 433 before the rangers were installed. Following the placing of the rangers and their wedging the first grouting was done above them. The clamshell then again operated, taking grade down 8 ft. more, and again the space between the 21-in. I-beams and the sheet piling was filled with grout.

Tremie-Deposited Concrete Prevents a "Blow"

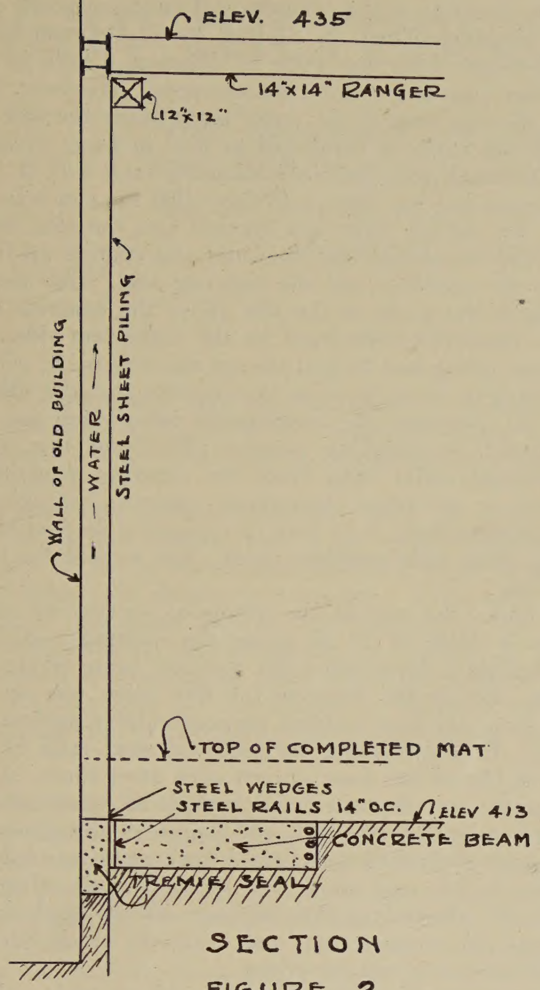
While the work inside the cofferdam was being carried on, a problem was encountered that bid fair to cause considerable trouble.

The steel sheeting along the old building (see Figure 2) and parallel to it was but 12 in. from the building at the top and in its driving the piling had a tendency to go toward the building. Therefore, at the bottom of this slot we had but a bare 9 in. in which to work.

The bottom of the new foundation, fortunately, had to be just 3 ft. above the old one, but this short space was too small for safety in case the lake pressure on the opposite side of the old building found some weak spots in the sandy soil underneath.

How to stop a "blow" was a problem. It was suggested that cement grout be forced into the sand below the old foundations. We therefore rigged up a grouting machine and under 100 pounds of air pressure tried forcing grout into the sand nearly 30 ft. below the surface. The attempt failed miserably.

Then came the one safe and reliable method, the tremie seal. But one problem still remained, that of removing the sand in the slot between the buildings. Many suggestions were made, and then finally came the solution.



SECTION
FIGURE 2

Excavating by Compressed Air

We had air pressure to the extent of 100 pounds per square inch. Why not use it? We did, and in the following manner.

The depth to which we had to excavate was about 33 ft. below the top of the sheeting. We therefore rigged up a 4-in. heavy wrought iron pipe (see Figure 3) of that length and fitted, to one end, an enlarged section of 8-in. outside diameter and 12 in. long, with a 4-in. hole at the end.

Out at the side of this we connected a 1½-in. air pipe and ran it up alongside the main pipe to its top. Here an air hose was connected. At the top of the 4-in. pipe were two 45-in. ells with a coupling between and a long nipple for a discharge pipe. The two pipes were clamped and bolted together to prevent twisting. A quick-shutting valve was used on the air line. When all was in readiness the load line from the derrick was fastened to the top of the 4-in. pipe and the whole contraption was hoisted into position.

At the first rush of air, water sprouted from the pipe in large volume, and as the engineer gently lowered the load against the sand a yellow stream poured forth. Stones as large as hens' eggs, and some larger, spouted forth. It worked so splendidly that it took but a very short time to remove all sand and stones to the depth required, leaving the slot filled completely with water, the top of which was approximately at lake level.

The Tremie Seal

Here we had a slot between the steel sheet piling and the old concrete foundation that was between 9 and 12 in. wide and 25 ft. deep, and about 70 ft. long. This slot was full of water and there was no chance to drain it. Even if the slot could have been drained it would not have been advisable, because of the danger of undermining the old foundation. Our desire was to place a sufficient amount of concrete at the bottom of this slot so that it might be effectually sealed.

This is the way it was accomplished. An 8-in., 16-gauge galvanized sheet tube 25 ft. long was used (see Figure 4). On one end of this a hopper was placed. This hopper was really only a belling or cone-shaped enlargement of the pipe, cold-riveted to it. The extension

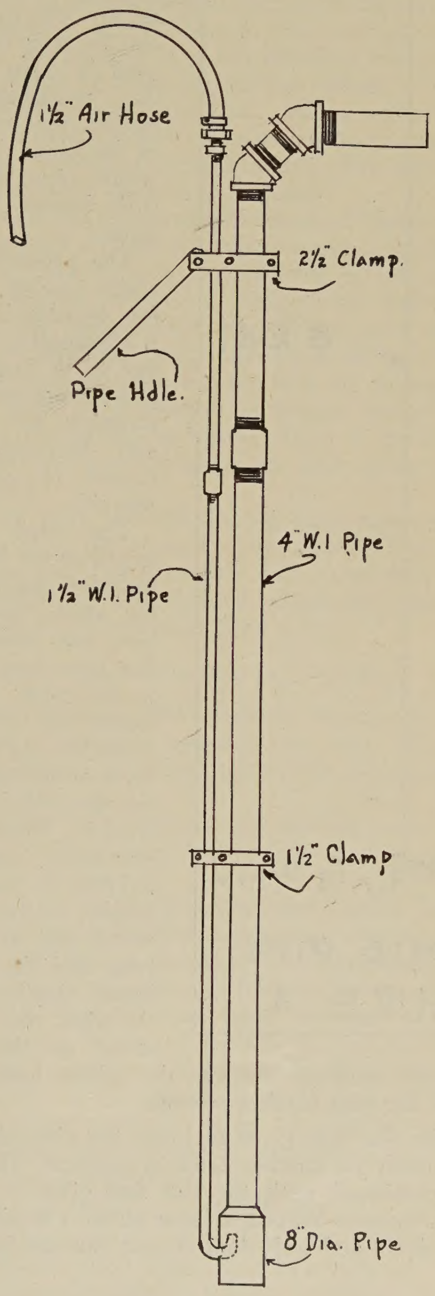
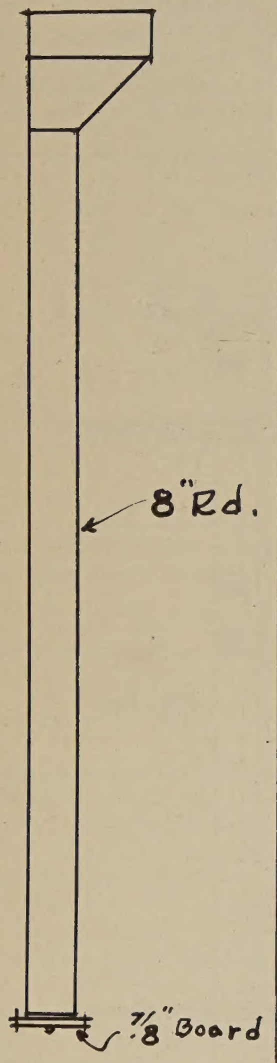


FIGURE 3

to the length of the pipe was about 24 in. and the diameter of the funnel was about 24 in., flattened on one side to allow it to lie close to the foundation wall.

In order to obtain a seal at the bottom of the pipe after it had been lowered into the water a rather crude but effectual method was employed. We used a ⅞-in. board a little larger in diameter than the pipe itself and tacked some ⅛-in. rubber packing to its surface. Making a very small hole in the center of the board, we passed a 14-gauge annealed wire through it and secured it on the under side, then passed the wire through the pipe from the lower end and fastened it at the top, where it could be released at the proper time.



TREMIE PIPE
FIGURE 4

Before starting operations the rubber packing was coated thickly with cup grease and the wire was tightened in order to hold the packing tight against the lower end of the pipe. Then the entire pipe was carefully lowered into the water.

The pressure of the water against the bottom assisted in sealing it effectually; but care had to be exercised to prevent the board from scraping the sheeting and becoming dislodged or moved to one side.

The pipe finally rested on the bottom of the slot, hard against the sand. An inspection was made to see that there was no water in the pipe. A large bucket of very slushy concrete was ready close to the hopper and the men filled the pipe from it. When the pipe was full it was slowly raised a sufficient height to release the wood seal at its bottom, and the concrete began slowly to leave the pipe. As one man stood on the hopper watching the receding concrete the others continued to fill it until our first batch was gone.

The order was then given to lower the pipe, thus again sealing it, ready for another batch of concrete. This operation was continued until the slot was given a sufficient amount of concrete to form a layer about 4 ft. thick. Our work was done, and well done except for one unforeseen condition.

Stopping an Unexpected Leak

As explained in the foregoing, the slot in which the concrete was placed was approximately 12 in. wide and about 25 ft. deep, with about 21 ft. of water above the concrete.

During the time the concrete was hardening, excavation was being carried on in the cofferdam adjoining. Before we realized it we had excavated to a grade approximately the same elevation as the concrete seal on the opposite side of the sheeting. Then we decided to let the water out from the slot. This was done by burning a hole in the steel sheet just above the concrete level. However, following the lowering of the water level inside the slot the flow did not stop. It continued to flow in large volume, and as it flowed we noted indications of sand with it.

There was but one answer to this—that the slot was not sealed. An electric light was lowered into the slot, when it was soon discovered that the water was coming up from between the sheeting and the concrete seal. Due to the pressure of the water in the slot above the concrete seal and the removal of the sand on the cofferdam side, the steel sheet piling had bulged toward the cofferdam, allowing a crack to occur between the concrete and the piling.

How to overcome the contingency into which we ran again taxed our thinking powers. We know that after steel sheeting pulls away from the concrete it incloses, and sand, or any other obstruction comes up through the space between them, it is next to a physical impossibility to bring them tight together again. But we did the next best thing.

Just under the mat in the adjoining section we excavated to a depth of 18 in. along the sheeting and 7 ft. wide, making a form for a flat concrete beam along the sheeting. Before the concrete for this beam was set we placed some old steel sections perpendicularly against the sheeting. In this instance we used old steel rails 18 in. long and placed the base against each steel sheet. After the concrete was deposited and had its set, steel wedges were driven between the rails and the sheet piling, and in this manner the piling was forced back again toward the concrete. It was very good, but not thoroughly effectual. However, it allowed us then to burn off the steel sheets just above the concrete seal and caulk the crack left between the concrete and the piling.

I cannot complete this narrative without giving those who intend using these methods one or two words of caution. In the use of compressed air for a contrivance, such as here described, too much care cannot be used. It is a dangerous plaything and might cause considerable bodily damage unless all fittings are extra heavy and tight. Have your men away from its discharge because these rocks come out with tremendous force.

Regarding the use of the tremie seal, do not allow any water to enter the pipe you are using at any time until you withdraw it from the water. If once withdrawn from the water or if the seal is broken, a new start must be made and the same operation repeated.

Allowable Loads on Open-Web Steel Joists

A simplified practice recommendation covering dimensions and allowable loads per linear foot of open web steel joists, was unanimously approved at a general conference of representatives of the industry, held under the auspices of the division of simplified practice of the Bureau of Standards, Department of Commerce, at the Hollenden Hotel, in Cleveland, Ohio, on July 15th.

It is expected that this simplification will greatly reduce existing confusion in the design of open web steel joist construction.

The recommendation, subject to approval of the industry, will be effective as of October 1, 1930.

How Products Manufacturers May Increase Business Volume

Well-Known Manufacturer Recommends Dealing in Special Building Materials—Cites Own Case as Example—Gives List of Materials Sold by His Company—Advises Against Entering Contracting Business

By AUSTIN CRABBS
President and Manager, The Cement Products Co., Davenport, Iowa

TO what extent may manufacturers of concrete products find it profitable to undertake related lines of business? What related lines of business are most likely to be profitable?

The answers to these questions, which the writer hopes to give in this article, are in no sense intended as a defense of the products manufacturer's right to take on other lines. No defense is necessary. Those who have a doubt on this point may be told that one of the largest concrete products manufacturing companies in Detroit also deals extensively in other building materials which the company does not manufacture. Many of the materials sold are in fact competitors of concrete masonry units.

All Business Branching Out

It is the same in almost every line of business. It is the modern trend, for do not our modern drug stores sell almost everything under the sun, from books and magazines to minced-ham-and-lettuce sandwiches? Numerous other lines of business are continually enlarging their scope and entering fields which formerly were thought to belong to other groups.

The writer feels that the injection of these preliminary comments is fully justified, for many a manufacturer of concrete products who may be considering the possibilities of dealing in related kinds of building materials, but who has not quite the courage, may find in this the necessary stimulant. Products manufacturers who are in this doubtful state of mind are found most commonly in the smaller cities and towns.

In the larger cities the custom of branching out into other activities has grown so general that it attracts but little attention. It is not the writer's thought that a manufacturer of concrete products should become a lumber dealer, or that he should deal in a complete line of building materials. Such a manufacturer would soon find himself a building material dealer making concrete products "on the side." He may, on the other hand, remain essentially a manufacturer who deals in other materials "on the side," if he will confine his side activities to the proper kinds of materials.

Diversified Products Plus Greater Volume

Manufacturers of concrete products, and more especially those whose plants are located in towns or in cities of small or medium size, must work toward three goals if they are to come out of the rut into which many have fallen. First, they must diversify their products; and, second, they must increase their volume of business, and third, they must keep fixed assets at a minimum.

The need for a greater variety of products has been emphasized in a most painful fashion in the last few years. Many products manufacturers who confined themselves strictly to the making of a few different sizes of concrete building units had made the further mistake of developing only the dwelling-house market. Along with the definite decline in dwelling-house construction these manufacturers found their market dwindling away. The result was exactly what should have been foreseen.

The second goal—increased volume of business—cannot now be attained through the sale of more concrete building units in a market where the products manufacturer himself has allowed builders to hold to the belief that his materials are suitable for dwelling houses only. His restricted market has been suffering a decline for several years. He can increase his business by selling concrete building units for the larger buildings, and he can also increase it by dealing in special lines of building materials. The latter method is the one with which this article is concerned.

The third goal, that of keeping fixed assets at a minimum, cannot be too strongly emphasized. That slight attention has been paid to this rule is evident in many plants throughout the country which are overburdened with excessive investment in fixed assets.

The Products Manufacturer as a Dealer

From the writer's own business experience it is his belief that a products manufacturer may logically and profitably become a dealer within the following limitations:

(a) He may be a jobber (or a manufacturers' agent, if that term sounds better) for various concrete specialties not made at his plant.

(b) He may be the manufacturers' agent for incombustible building specialties other than concrete products.

(c) He may deal in so-called permanent building material specialties in common use but which may not be sold by other local dealers to any great extent.

The foregoing can be illustrated to the best advantage by referring to our own organization, The Cement Products Company, of Davenport, Iowa, a city which may be classed as one of medium size by virtue of its population of a little less than 65,000 in the census of 1930. In this plant* we manufacture

(1) Concrete masonry building units.

(2) Architectural cast stone, such as exterior and interior trimstone, sills, lintels and belt courses.

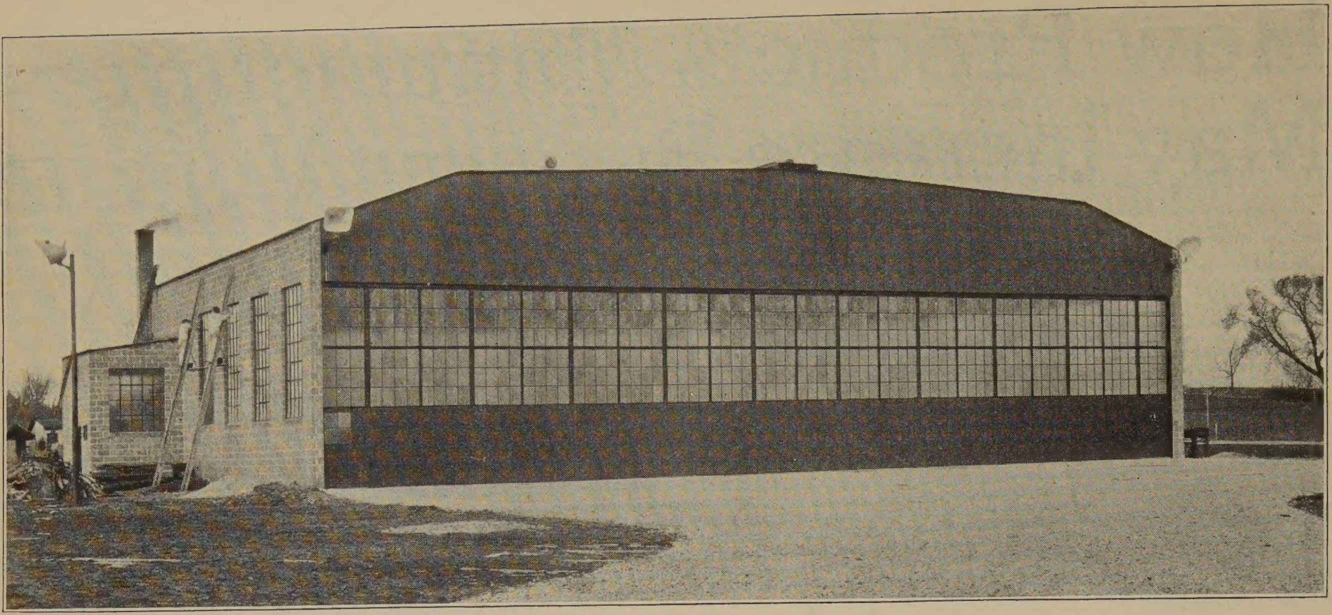
(3) Ornamental concrete garden furniture.

(4) Concrete septic tanks.

The products in connection with which The Cement

---

*See July, 1930, issue of CONCRETE, page 20.



The company that made the concrete building units in the walls of this hangar also sold the steel window frames and sash in the side walls and the patented steel hangar doors

Products Company plays the part of dealer fall, with one exception, within the limitations mentioned above in the short paragraphs headed (a), (b), and (c).

Concrete Specialties Made by Others

For instance, we act as jobbers or manufacturers' agents for the following concrete specialties not made at our plant:

(1) Large cement roofing tile for industrial buildings.
(2) Colored concrete roofing tile for dwelling-houses and similar buildings.

One can readily see that it would not be profitable for us to install the special equipment required to make roofing tile of either of the foregoing types. Such equipment is rather expensive, and a separate building or an extension of our present building would be required to house it. The limited demand in our city for these special products would not justify the additional plant investment.

On the other hand, there is some demand in Davenport for both of these products, and some dealer will handle them. Who is better qualified to handle them than a manufacturer of other concrete products?

Specialties Other Than Concrete Products

The second group listed above includes building specialties, other than concrete products, which may be regarded as permanent building materials. No one expects these materials to last forever, but they are incombustible materials which form a part of our modern fireproof structures such as hotels, apartments and office buildings. Our organization acts as the manufacturers' agent for the following materials in this group:

(1) Special system of concrete reinforcing steel.
(2) Steel window frames and sash.
(3) Hollow metal doors.
(4) Tin-clad doors.
(5) Rolling steel doors.
(6) Elevator doors.
(7) Steel toilet partitions.
(8) Steel lockers.
(9) Steel bathroom cabinets.
(10) Concealed beds.
(11) Metal safety stair treads.
(12) Metal deck roofing.

Here, again, we feel that it is altogether logical that the foregoing materials should be sold by the concrete products manufacturer who makes concrete partition and back-up units and other fireproofing materials for the same types of buildings in which these specialties are used.

Special Materials Commonly Used

The materials falling under the third classification which we handle as dealers include the following:

(1) Waterproofing materials.
(2) Composition flooring materials.
(3) Masonry units such as clay brick.
(4) Wood block flooring.
(5) Cement paint made from portland cement base.

When a contract is awarded for a building, a certain amount of materials included in these groups will be required. A concrete products manufacturer who will take the time to learn about these materials so as to be able to recommend to a customer what he should use in a particular place is thoroughly justified in handling these products as a dealer.

Material for an Airplane Hangar

The manner in which this method of increasing business works out in actual practice is further emphasized in the case of an airport hangar built at Cram Air Field, in Davenport. The hangar, 60 by 120 ft. in plan, is shown in the accompanying illustration. We manufactured and sold the concrete masonry units in the walls of this building, and we sold the steel window frames and sash in the side walls and the patented steel hangar doors along the front. The volume of business we obtained from this building was very materially increased over what it would have been if we had furnished the concrete masonry units alone. In fact, the hangar doors themselves amounted to more in dollars than the entire block sale.

Increase in Volume of Business

This brings us directly to the question of the increase in volume of business which a products manufacturer might expect as a result of dealing in materials of the character described above. It would be misleading to attempt to establish even an approximate figure as the probable percentage of increase, for the variation would be quite large in different cases. It will be sufficient to say that the increase in business volume in our case is a substantial amount, large enough to make it well worth while, and to make an appreciable difference in the results of a year's business.

In our letterheads we make known the fact that we deal in these special materials. Immediately under the main letterhead, consisting of the company name, we have a line in a little smaller type reading "Permanent Building Materials." In the left-hand margin of the letterhead we list the products manufactured and those for which we act as manufacturers' agent. In this way our sales department has larger possibilities to work on when a new building project is on the boards of an architect.

What About the Contracting Business?

Some manufacturers of concrete products will, quite possibly, ask themselves whether they might not dispose of a greater amount of their products by entering the contracting business as a sideline. The writer does not recommend this, for several reasons. In the first place, a products manufacturer is supposed to be equipped to make and sell materials to be bought and used by contractors in the construction of buildings. If he undertakes to enter the contracting business as a sideline he will be competing against the very contractors to whom he hopes to sell some of the materials which he manufactures. He will surely incur the ill will of those contractors against whom he bids, and will probably lose much more than he can gain by going into the contracting business himself.

No situation of this kind exists when a concrete products manufacturer undertakes to sell other building materials in addition to the materials he manufactures. He will compete only with other material dealers, to whom he has nothing to sell and from whom he buys very little. Very often, too, the products manufacturer who handles other materials as a dealer can obtain the dealer discount on the cement he buys. This in itself is no small item, and is well worth weighing in the balance.

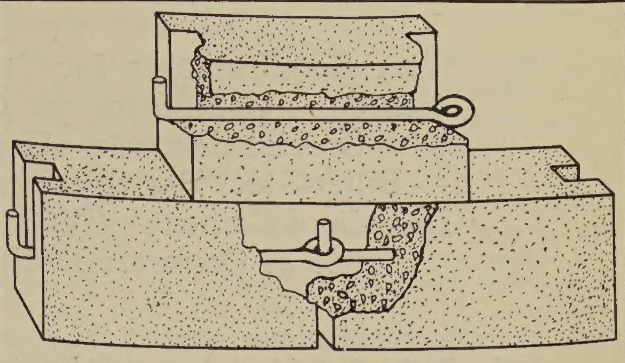
While the addition of outside lines will in many cases help and strengthen a concrete products business, no discussion of this kind would be complete without a word of warning. As one recent writer aptly stated, American business has perhaps become somewhat infected with a disease that this writer terms "sideline-itis," which is the mistake of trying to sell too many different lines without regard to how they may fit into his particular business or how well qualified he is to sell them. No sideline should be taken up that puts the products man into an already overworked field or unless by handling this new line, he can perform an added service to his community.

Improved Concrete Units For Tanks and Silos

Hooks and Eyelets in Bars of Mild Steel Provide Continuous Reinforcement—Special Joints Filled With Concrete

By DALE R. VAN HORN

FOR several years farmers in the eastern part of Nebraska have become increasingly interested in an improved type of concrete block which seems to have eliminated about all the remaining objections to this type of construction. Simple in itself, the improvement is sound and practical. It consists of a single rod of mild steel extending lengthwise through the block. One end protrudes in an upturned right-angled hook two inches high. The other end is bent to form an eyelet, and projects far enough so that the upturned hook at the end of one block will fit up through this eyelet of the next block when two adjoining blocks are laid in the wall. This forms a rigid type of reinforcement which has neither "give nor take." The space intervening, of course, between adjoining block ends, is filled with rich concrete mortar, and the joint becomes a mass of reinforced concrete.

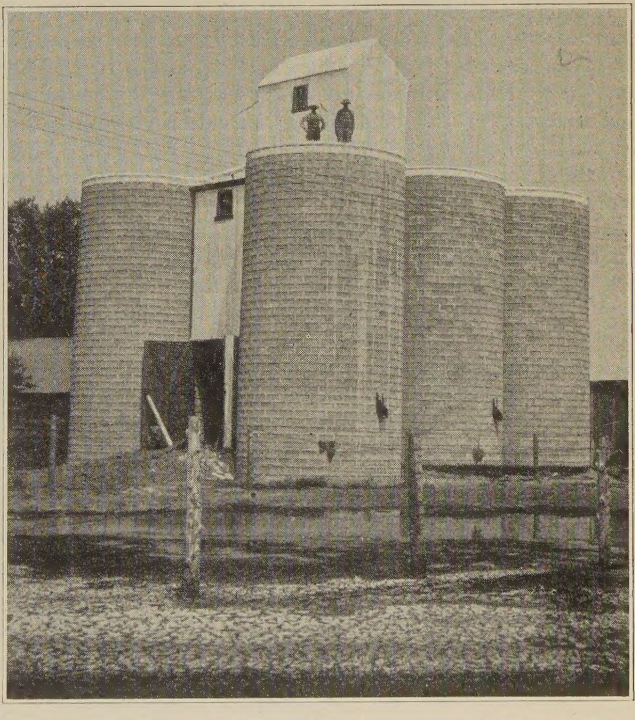


DETAIL OF HOOKED REINFORCEMENT IN BLOCKS FOR SILO WALLS.

The accompanying photograph shows a splendid type of grain elevator on the farm of Charles McCarty, near Central City, Nebraska. This installation comprises six units, each 14 feet inside diameter, and 36 feet high above the foundation. The roof slab is of monolithic concrete. The penthouse which houses the elevator machinery is likewise of monolithic concrete.

The blocks of which the tank walls are built are 4 inches thick, 8 inches high, and 16 inches long. They are cast in a machine under considerable pressure, with a mixture of one part of cement to three parts of washed sand. The reinforcing employed is a mild steel rod of 5/16 or 3/8 inch diameter. Suitable lengths are cut and bent to shape beside the casting machine as they are needed.

W. B. and C. B. Hester, of Lincoln, Nebraska, have been employing this improved block in their contracting work among the farmers in their part of the state.



Nebraska farm grain elevator tanks near Central City in which new type of concrete unit is employed

Cement and Concrete Play Important Part in A. S. T. M. Meeting

Test Requirements for Standard Portland Cement Increased — Committee on Cement Reorganized to Deal with Special Cements—Urge Change in Acceptance Test — Billet-Steel Bar Specifications Altered—Variations in Brands of Cement—Tests of Haydite Concrete—Resistance of Concrete Drain Tile to Sulphate Waters

THE Thirty-Third Annual Meeting of the American Society for Testing Materials, held at Atlantic City from June 23rd to 27th, inclusive, dealt with many phases of the manufacture and use of cement and concrete.

Cement Test Requirements Increased

Outstanding among the developments was the adoption of higher mortar tensile strength requirements for standard portland cement. Under the revised specifications the 7-day requirement is raised from 225 to 275 lbs. per sq. in. and the 28-day requirement is increased from 325 to 350 lbs. per sq. in. In consequence, the standards in force since the 1926 meeting are now supplanted by this latest revision.

Other Kinds of Cement

Committee C-1 reported activity in other directions, notably its recommendation of a tentative standard for high-early-strength portland cement, the recommendation having been accepted some months ago by Committee E-10, as reported on page 26 of the April issue of CONCRETE. This new tentative standard has been assigned the serial designation of C-74-30 T.

Committee C-1, during the past year, also discussed the proposed revision of the standard specifications for natural cement and a new specification for masonry cement. Both cases were referred back to the respective sub-committees for further consideration, and it is expected that these items will be up again for discussion at the next meeting of the committee. In addition, Committee C-1 will probably give attention soon to still other kinds of cement, especially to high-alumina and puzzolanic cements.

In view of the diversified work ahead for Committee C-1, this body was reorganized in such a way that special subjects may be handled by sub-committees appointed for short periods of time. By following this method it is hoped that the work of the committee will be of greater interest to the committee members themselves.

The interest in special cements seems to be gaining with each year, as indicated by the fact that no less than 23 different manufacturers are now producing so-called masonry cements.

Hydration of Cement Clinker

A paper of direct interest to the manufacturer of cement, rather than the user, consisted of Parts II and III of a concise treatise entitled "The Rate of Hydration of Cement Clinker," by F. O. Anderegg[1] and D. S. Hubbell.[2] Part I was presented at the 1929 annual meeting of the A. S. T. M. The authors reported that particles of standard portland cement, originally ranging in size from 15 to 25 microns, were found to be approaching apparently complete hydration in nine months, while at 12 months hydration was practically finished. A white portland cement and a high-early-strength portland cement seemed to reach a similar degree of hydration in a shorter time.

The authors reported further that during the past year they have extended their studies to include samples of tricalcium aluminate, tricalcium silicate, dicalcium silicate and calcium ferro-aluminate. Particles of tricalcium aluminate of a dimension of about 25 microns were about three-quarters hydrated in 3 hours, tricalcium silicate particles of about the same size were hydrated to a similar degree in about 7 days, while with dicalcium silicate this amount of hydration was reached in about 5½ months.

Compare Eighteen Brands of Cement

C. H. Scholer[3] and L. H. Koenitzer[4] presented a complete study of variations in quality among 14 brands of standard portland cement and 4 high-early-strength cements, with particular reference to their concrete-making qualities. In general, the various brands maintained rather unusual uniformity. An abstract of this paper is printed elsewhere in this issue of CONCRETE.

Questioning the Sand-Mortar Test

The efficacy of the 1:3 mortar briquette tensile test as a measure of the strength of a cement when used in concrete was again questioned during the discussion of a paper presented by J. R. Dwyer[5] and P. H. Bates,[6] on "The Relation Between the Strengths of Cements Developed by Mortar Specimens and Concrete Specimens." As the paper indicated, the ratios of mortar strength to concrete strength developed by the different brands of cement varied with age, with the kind of mortar specimens employed, and with the kind, the grading and the proportioning of the concrete. Different kinds of aggregates also produced variations in the strength of concrete, and consequently in the ratio between mortar strength and concrete strength.

In the discussion several speakers mentioned the practice of the testing laboratory of the Lehigh Portland Cement Co., where plastic mortar cubes are tested in compression, in contrast to the present standard method of testing mortar briquettes in tension. At this laboratory a number of tests had pointed to a similar conclusion, namely, that the strength relations between cements vary with different water-cement ratios, and with different proportions between fine and coarse aggregates, to the extent that the relative strength of a brand of cement in a mortar tensile test is not indicative of its relative strength in a mixture of concrete.

---

[1] Senior industrial fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

[2] Industrial fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

[3] Professor of applied mechanics, Kansas State Agricultural College, and Consulting Engineer, Kansas Highway Commission, Manhattan, Kans.

[4] Instructor in applied mechanics, Kansas State Agricultural College, Manhattan, Kans.

[5] Research associate, Bureau of Standards, Washington, D. C.

[6] Chief, Clay and Silicate Products division, U. S. Bureau of Standards, Washington, D. C.

On the other hand, tests at the cement company's laboratory indicated that the compressive strengths of plastic mortar cubes agreed with compressive strengths of concrete cylinders within 2 per cent between the ages of 4 and 12 months. At ages less than 4 months the compressive strengths of the plastic mortar cubes ran about 10 per cent below the corresponding concrete strengths. Furthermore, the age-strength curves of specimens made from four brands of cement were closely identical as between the plastic mortar compression cubes and the concrete compression specimens, while the graph representing tensile strengths of briquettes made from the same cements was a straight line, considerably below the curves.

Further discussion on the question of compression tests on mortar cubes, rather than tensile tests on mortar briquettes, was offered in the report of Committee C-1. That committee reported having continued its study of the subject, through a series of tests conducted by ten laboratories, four different brands of cement having been used. In this series the making of specimens was extended over a period of five weeks, a complete set of tests having been made by each laboratory each week.

Flow of Concrete

R. E. Davis[7] and H. E. Davis[8] contributed a paper on "Flow of Concrete Under Sustained Compressive Stress." The paper describes a series of laboratory tests from which the conclusions drawn were that flow continues under sustained compression for a long period of time; that it is greater in a dry concrete than in the same concrete when wet; that it is materially affected by the kind of aggregate; that it is less in rich mixtures than in lean mixtures; that it increases directly with the water-cement ratio; and that it increases rapidly with the magnitude of the sustained unit stress.

Variations of Compressive Strength

A paper on "Variations of Compressive Strength of Concrete Within the Water-Cement Ratio Law" was presented by Ira L. Collier, assistant professor of civil engineering, University of Washington, Seattle, Wash. The paper describes three series of tests comprising 450 specimens. The tests indicate that the compressive strength of concrete mixed with the same water-cement ratio decreases as the slump increases. In general, the strength also decreases as the percentage of sand is decreased, and as the fineness modulus of the sand increases.

Haydite Concrete

"Tests of Plain and Reinforced Haydite Concrete" is the title of a paper contributed by F. E. Richart[9] and V. P. Jensen.[10] The paper discusses the structural properties of haydite concrete as employed in reinforced concrete buildings. The investigations included mixtures in which haydite was used as both fine and coarse aggregate and others in which natural sand was used as the fine aggregate. The scope of the tests included 75 beams, 27 bond pull-out tests and nearly 1,000 compression tests on cylinders. The strength and other properties of all-haydite and sand-haydite concretes compared favorably with corresponding mixtures of ordinary concretes of sand and gravel and of sand and crushed limestone. The weight, as would be expected, increased with the increase in richness, varying from 93 to 106 lbs. per cu. ft. for all-haydite concrete, and from 112 to 126 lbs. for sand-haydite mixtures. These tests are still in progress.

Concrete Drain Tile

The subject of concrete drain tile was treated in two papers, one of which was a report of Committee C-6, including abstracts of several researches. Another paper was presented by Dalton G. Miller[11] under the title of "Strength and Resistance to Sulphate Waters of Concrete Cured in Water Vapor at Temperatures Between 100 and 350 deg. F." The test results indicated that variations between 100 and 350 deg. F. in the temperature of the water vapor had little effect on strength, but a marked effect on resistance to sulphate waters. Up to 190 degrees not much difference was noted; but from 212 degrees upward there was a definitely increased resistance to the action of sulphate waters, more especially in the range from 212 to 260 degrees. The tests covered in this paper are being continued.

Change Specifications for Billet-Steel Bars

The specifications for billet-steel reinforcement bars (A15-14) were changed in several important respects. One change included the elimination of Paragraph 2 (a), reading "The structural-steel grade shall be used unless otherwise specified." Elimination of this paragraph removes an obstruction to the trend toward the intermediate grade as the standard. Other changes included an increase from 85,000 to 90,000 lbs. per sq. in. as the upper limit of the ultimate strength of intermediate grade billet-steel bars, and a change in elongation requirements for the intermediate grade whereby the minimum is now 16 per cent for plain bars and 14 per cent for deformed bars regardless of the ultimate strength of the steel.

More Contributions From Prof. James R. Griffith

IN our July issue we concluded the second series of articles by Prof. James R. Griffith, on the important subject of "Reinforced Concrete Design Simplified." A third and final series extending through three or four issues will be started in September, thereby bringing to a close a series of design charts which, we have reason to know, have been most helpful to architects and structural engineers.

In the belief that those of our readers who have studied and used Prof. Griffith's charts will welcome other contributions from him, we are planning another series by this writer, in which he will present time-saving charts applicable to various problems encountered in the designing office.

In connection with this later series we urge architects and structural engineers to tell us of problems which they would like to have prepared in chart form. In this way the charts can be made of the greatest possible utility.—The Editors.

---

[7] Professor of civil engineering, Univ. of Calif., Berkeley, Calif.

[8] Instructor in civil engineering, Univ. of Calif., Berkeley, Calif.

[9] Research associate professor of theoretical and applied mechanics, Univ. of Illinois, Urbana, Ill.

[10] Special research assistant, theoretical and applied mechanics, Univ. of Illinois, Urbana, Ill.

[11] Senior drainage engineer, U. S. Bureau of Public Roads, St. Paul, Minn.

Keeping Ahead of the Times in Paving Practice

Bethlehem, Pa., Combines Research and Construction in Practical Way—New Ideas Thoroughly Tested Before Adoption—Limestone Screenings as Fine Aggregate—Careful Field Inspection

THE city of Bethlehem, Pennsylvania, has been building concrete pavements exclusively since 1923. At the present time more than 200,000 sq. yds. of concrete pavements are serving traffic, of which total 60,000 sq. yds. were built in 1929 alone. Concrete was first used for paving in Bethlehem in 1921 and with one or two exceptions larger and larger yardages have been laid year by year.

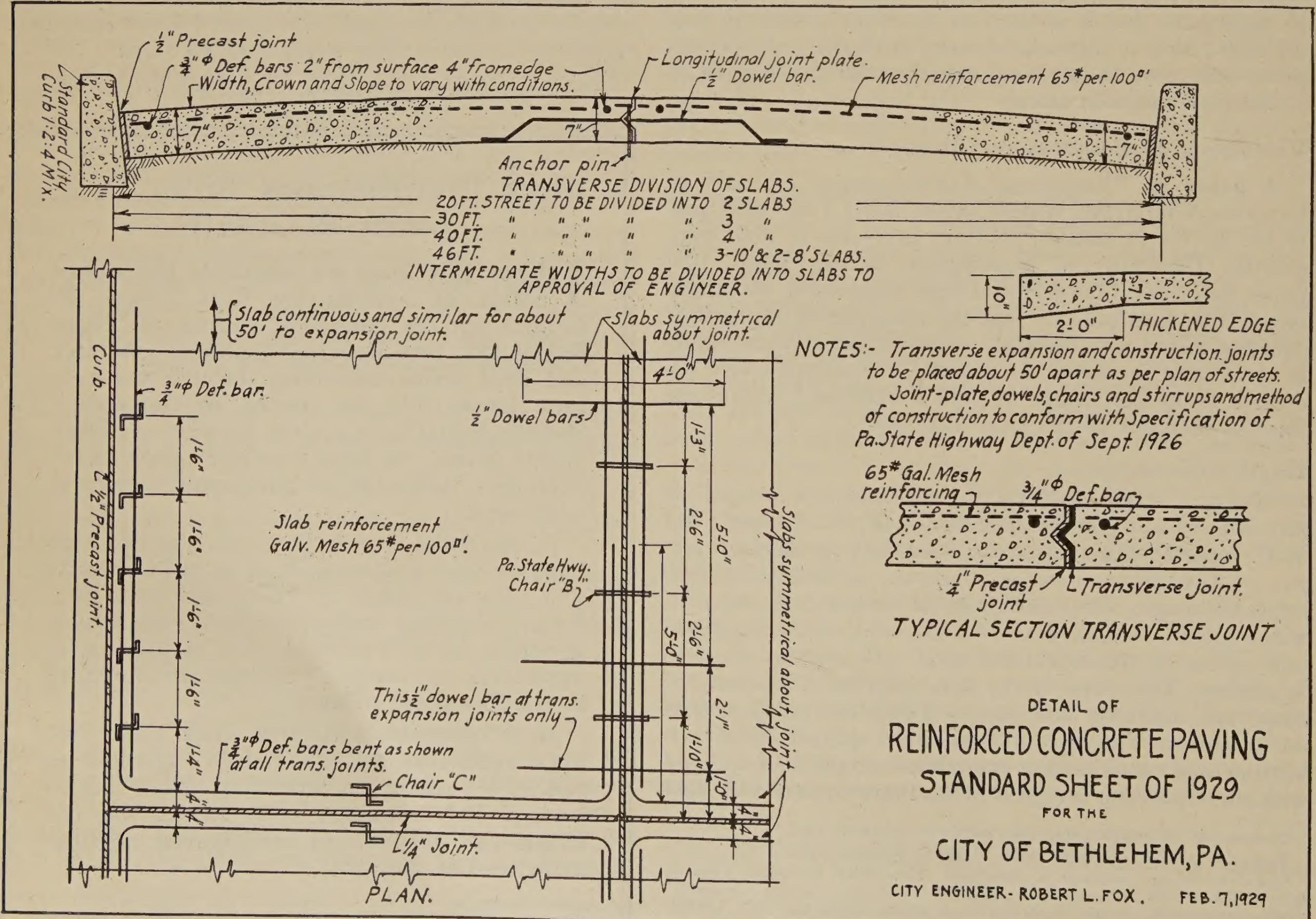
The remarkable feature of the concrete pavements, however, is not their amount, but their generally good design and construction. This quality of design and workmanship is due primarily to continual effort on the part of the engineering department and contractors to take advantage of all betterments and to pioneer in methods of doing things.

New Methods and Designs Are Tested

Designs have been bettered from year to year, and changes in construction practices have been adopted as they have been used elsewhere. In addition, no change is incorporated until its value is tested as far as possible. The watchword has been "Test everything, and when good adopt it!" This policy has resulted in testing aggregates, reinforcing, thickness, cross-section, amount of water and cement, finishing and curing.

The quality of the concrete pavements is insured first of all by making certain that the materials used are of high quality and that they are structurally sound and adapted to Bethlehem's design and construction practices.

Bethlehem does not use sand, but uses a crushed and washed limestone screening or chips as fine aggregate. This material was adopted, first, because of its considerably lower price, 75 cents as against $1.40 per ton f.o.b. cars, and second because it compared favorably with the most widely used testing sand, Ottawa sand. In addition to lowering the cost, the use of this material has resulted in increased compressive strengths in test cylinders and pavements.


½" Precast joint
¾" ϕ Def. bars 2" from surface 4" from edge
Width, Crown and Slope to vary with conditions.
Longitudinal joint plate.
½" Dowel bar.
Mesh reinforcement 65# per 100□'
Standard City Curb 1:2:4 Mix.
7"
7"
7"
Anchor pin
TRANSVERSE DIVISION OF SLABS.
20 FT. STREET TO BE DIVIDED INTO 2 SLABS
30 FT. " " " " " 3 "
40 FT. " " " " " 4 "
46 FT. " " " " " 3-10' & 2-8' SLABS.
INTERMEDIATE WIDTHS TO BE DIVIDED INTO SLABS TO APPROVAL OF ENGINEER.
10"
2'0"
THICKENED EDGE
Slab continuous and similar for about 50' to expansion joint.
Slabs symmetrical about joint.
4'0"
Curb.
¾" ϕ Def. bar.
½" Dowel bars
1'6"
1'6"
1'6"
1'6"
1'4"
4"
4"
1'3"
2'6"
5'0"
2'6"
5'0"
2'1"
1'0"
1'0"
4"
4"
½" Precast joint.
Slab reinforcement Galv. Mesh 65# per 100□'.
Pa. State Hwy. Chair "B"
This ½" dowel bar at trans. expansion joints only
¾" ϕ Def. bars bent as shown at all trans. joints.
Chair "C"
¼" Joint.
Slabs symmetrical about joint
PLAN.
NOTES:- Transverse expansion and construction joints to be placed about 50' apart as per plan of streets. Joint-plate, dowels, chairs and stirrups and method of construction to conform with Specification of Pa. State Highway Dept. of Sept. 1926
65# Gal. Mesh reinforcing
¾" ϕ Def. bar
¼" Precast joint
Transverse joint.
TYPICAL SECTION TRANSVERSE JOINT
DETAIL OF
REINFORCED CONCRETE PAVING
STANDARD SHEET OF 1929
FOR THE
CITY OF BETHLEHEM, PA.
CITY ENGINEER - ROBERT L. FOX.
FEB. 7, 1929

Thorough Investigation of Limestone Screenings

Before this material was adopted exhaustive tests were made of its strength, absorption and grading. The Department of Civil Engineering of Lehigh University ran a series of standard mortar briquette tests, comparing the crushed limestone with Bay sand, Kenville sand and Ottawa sand. The results were as follows on specimens seven days old:

MORTAR BRIQUETTE TEST

Test No.	Strength in Lbs. Per Sq. In. Bay Sand	Kenville Sand	Ottawa Sand	Crushed Screenings
1	375	323	262	438
2	344	271	306	382
3	386	288	269	443
4	354	294	284	450
5	326	342	282	507
6	371	324	263	491
Average	360	310	280	450

The fine aggregate was further tested by comparing it to Ottawa sand and a fine grade local sand known as Succasunna sand in a series of tensile and 2- by 4-in. cylinder compressive tests. The tensile tests are the averages of the results of six specimens, while the compressive tests are the results of averages of five specimens. All specimens were seven days old when tested. The results of this series were as follows:

	Strength in Lbs. Per Sq. In.	
Tensile Test	1:3 Mix	1:2 Mix
Ottawa Sand	194	268
Succasunna Sand	184	212
Limestone Screenings	230	298
Compressive Test on	Strength in Lbs. Per Sq. In.	
2- by 4-in. Cylinders	1:3 Mix	1:2 Mix
Ottawa Sand	875	1510
Succasunna Sand	710	1450
Limestone Screenings	1570	2200

The city engineers were not content to rest with 7-day strengths, but tested the same materials with the same mixes at the age of 28 days. These tests were made by the Fritz Engineering Laboratory, of Lehigh University. The 28-day tests were as follows:

Compressive Strengths, 28-Day Specimens, Lbs. Per Sq. In.

	Ottawa Sand		Succasunna Sand		Limestone Screenings	
Spec. No.	1:3	1:2	1:3	1:2	1:3	1:2
1	1620	4160	1220	2940	3840	5260
2	1120	3470	1770	2500	4120	4670
3	1640	4130	2220	2720	4120	4680
4	1490	4560	1460	3200	4070	5060
5	2240	4460	1570	2600	4440	5150
Average	1620	4155	1670	2790	4120	4965

Tensile Strengths, 28-Day Specimens, Lbs. Per Sq. In.

	Ottawa Sand		Succasunna Sand		Limestone Screenings	
Spec. No.	1:3	1:2	1:3	1:2	1:3	1:2
1	297	425	214	317	554	609
2	270	476	268	339	552	612
3	354	430	230	429	604	545
4	300	444	235	397	556	609
5	297	488	280	411	587	544
6	311	441	270	407	582	594
Average	305	450	250	363	573	584

Some indications of the grading and fineness modulus of these screenings was desirable, since it was known that the use of this comparatively harsh and gritty material might easily affect finishing and labor costs. Several sieve analyses have been made from time to time, all analyses showing about the same thing and also demonstrating that the material runs quite uniformly in grading over a period of years.

A typical sieve analysis of the screenings follows:

SIEVE ANALYSIS OF AGGREGATES

Per Cent of Sample Coarser Than a Given Sieve

Sieve Size	Size of Square Opening In.	Succasunna Sand No. 1	Succasunna Sand No. 2	Limestone Screenings No. 1	Limestone Screenings No. 2
100-Mesh	0.0058	96.3	95.8	95.7	95.8
48-Mesh	0.0116	76.4	80.7	88.1	87.1
28-Mesh	0.0232	37.6	38.1	77.0	75.3
14-Mesh	0.0460	13.1	13.7	62.6	61.1
8-Mesh	0.0930	0.2	0.2	35.7	34.6
4-Mesh	0.1850	0.0	0.0	1.4	1.3
⅜-Mesh	0.3710	0.0	0.0	0.0	0.0
Fineness Modulus		2.23	2.28	3.60	3.55

	Succasunna	Limestone Screenings
Per cent retained on 50-mesh sieve	100	90
Per cent passing ¼ in. sieve	78	99

Because of the close control over the materials entering the mix, the engineers were careful to take into account any effect the aggregates might have on the water content. Had one of the usual sands been used, absorption might not have been investigated except casually; but with screenings, absorption was important. If the screenings proved unusually receptive to moisture, serious changes might occur during mixing, resulting in a lack of uniformity. So absorption tests are run from time to time. These tests are closely supervised and conducted under laboratory conditions.

The tests are made on blocks 8 by 3¾ by 2¼ in. in size. After casting, the blocks are cured for 24 hours in a damp closet and are then heated at room temperature until constant weight is reached. The blocks are then immersed in water and tested. By way of showing results, a series of tests of the limestone screenings and Succasunna sand is hereby given:

RESULTS OF ABSORPTION TESTS

Period of Immersion	Limestone Screenings Weight in Grams	Gain	Succasunna Sand Weight in Grams	Gain
Dry weight	2506	—	2259	—
24 hours	2672	166	2437	178
48 hours	2674	168	2440	181
72 hours	2680	174	2444	185

Limestone screenings absorbed 174 grams, or 6.95 per cent, in 72 hours.

Succasunna sand absorbed 185 grams, or 8.20 per cent, in 72 hours.

This test, typical of the absorption tests, indicates that the absorption of the screenings is somewhat less than that of the local sand. From tests of this kind the engineering department made certain that the batches would be uniform in water content with consequent uniformity of mixed concrete.

Design and Construction Practice

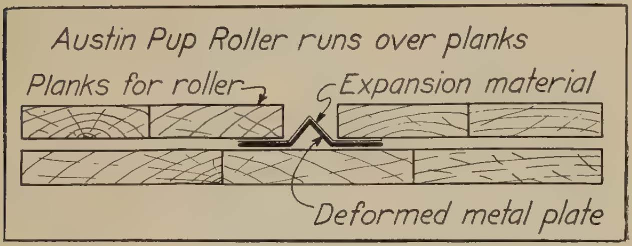
These researches into materials have been paralleled by advances in design and construction practices. At the same time thought is given street improvement, so that completed pavements adequately meet traffic requirements.

The slab now laid is uniformly 7 in. thick. A feature of the design is the use of thickened edges along car track areas, manholes, inlets and other street structures. The thickened edge is not used along curb and gutters or longitudinal joints, as the engineers feel their standard slab is heavy enough for these locations. At the end of concrete pavements, however, a thickened edge is used to give added strength against the wear found where traffic goes from one type of pavement to another.

The pavements are always divided longitudinally for traffic guidance and to make laying easier. Streets in multiples of 10 ft. are divided into 10-ft. slabs. The 36- and 40-ft. streets are divided into 10-ft. traffic lanes and 8-ft. parking lanes. The joint is marked by painting over the joint filler. All longitudinal joints are made with a deformed plate and dowels are spaced at 3-ft. intervals.

The transverse joints used in Bethlehem are unusual in several respects. Unlike the longitudinal joints, no dowels are used; but like the longitudinal joints, a deformed metal plate is incorporated. This metal plate also carries premolded filler pressed on it on the job. The metal plate has a triangular deformation.

The process of pressing the filler onto the plate was worked out by the engineers and has proved unusually efficient and a time and labor saver. The deformed plate is placed upon two pieces of planking. The space between the planks, and extending up into the deformation, is filled by a specially cut block to give stiffness. The top of the plate is then painted with hot asphalt and the expansion material is laid on top of the plate. Two strips of planking are then placed on the edges of the filler material and an Austin Pup roller is run over the planks. The roller forces the filler into conformity with the deformation and presses the filler upon the metal plate. Usage has proved that adherence between plate and filler is very tenacious.



Pressing the filler on the expansion joint plates

This method was first used in 1927. At first costs were about five cents per linear foot, but as the trick was learned and workmen became proficient this cost was reduced considerably. With this type of joint there has been no cracking along joints, and not one of the joints has lifted. More than 100,000 sq. yds. of pavement have been laid with this joint with excellent results.

Work Carefully Inspected

The concrete is kept under constant surveillance at the job. The amount of water is watched and five gallons of water per sack of cement is specified. This does not include the moisture in the aggregate, but this has been found to be both low and consistent. Slump tests are made right along, and the engineers have developed mixing so that slumps of from one to one and one-half inches are consistently maintained. This slump, with the kind of fine aggregate used, results in a somewhat harsh mix, but finishing operations used overcome this difficulty.

After the concrete is screeded to shape a hand roller is run over the surface. With the amount of water and fine aggregates used very little water comes to the surface and laitance is unknown. The rolling is followed by two beltings. The first belting is run transversely of the pavement in the usual manner. Unlike ordinary practice, however, the final belting is done longitudinally. Two bridges are used and the belt is a strip of burlap. This belt is run back and forth with the movements overlapping to eliminate ridges. The engineers have found that these finishing operations have resulted in remarkably smooth pavements, devoid of ridges or unequalities.

The work of the engineering department is under the jurisdiction of the city engineer, Robert L. Fox. The tests were made by outside laboratories working in conjunction with the engineering department.

Properly Made Concrete Resists Sea Water

Since 1916 a committee of the British Institution of Civil Engineers has been investigating the deterioration of structures of metal and concrete in sea water, with the co-operation of the Department of Scientific and Industrial Research of the Board of Trade and other bodies. Most of the work has consisted in observing the effects on various materials of exposure both in practical and in laboratory conditions to destructive influences for a period of years with and without definite protection. The first report appeared in 1920 and since then nine further interim reports at approximately annual intervals, have been issued. The latest of these has just been published under the editorship of John Purser and H. J. Grose.

A section of it is devoted to an account of observations which have been in progress at Brisbane on various specimens of reinforced concrete since 1917, and structures have been under observation after treatment by various preservative methods. The observations are being continued and are giving indications of practical value. It has been decided that a general investigation is to be made at the Building Research station under the direction of Dr. R. E. Stradling to determine the resistance of various concrete mixtures when exposed to sea water under conditions as nearly as possible comparable with those found in engineering practice. This comprehensive investigation will be made partly at the Building Research Board's station with artificial sea water, partly in a sea water tank at Sheerness, and partly on specimens sent for exposure to the Gold Coast with the object of obtaining result of laboratory and exposure tests in a temperate climate and of tests under tropical conditions. The tests will include the use of trass either as a constituent of the cement or as a part of the aggregate, so as to ascertain the extent, if any, to which pozzolanic action enters into the protective character of the coating.

The results of these experiments will be awaited with widespread interest. Meanwhile, a statement made in a recent lecture by Professor S. M. Dixon, is worthy of note. He admitted that cases of serious deterioration of reinforced concrete structures in sea water had recently been brought to light, but declared that an investigation into causes, aided by relevant experiments, confirms the belief of engineers that there is no danger of such deterioration occurring so long as the reinforcement is amply covered by concrete made of good materials, properly proportioned, well mixed, and carefully laid. The problem of remedying already deteriorated structures may be very difficult, but Professor Dixon stated that the deterioration is preventable in the first instance.

~ EDITORIAL ~

A Menace to Concrete Highways

HEAVY motor trucks used in highway freight transportation are becoming an increasing menace to the durability of paved highways. With concrete constituting the greater part of highway pavements of the first class, the menace concerns this material in particular.

Highway freight transportation has come to stay. It is a part of our commercial transportation system. The unfortunate feature about it is that the companies owning the trucks are not required either to build or to maintain the roads on which the trucks are operated. As a result of this situation the truck types are continually being increased in size and carrying capacity, until many of them are huge box cars on rubber-tired wheels. In states where permissible wheel loads are limited to certain maximum weights, the regulations are circumvented by using trailers or six-wheelers or combinations of both. State laws limiting total loads are difficult to enforce, for the highway police can not keep up a continual check.

Under the circumstances the increase in wheel loads and total loads goes merrily on, the trucking companies knowing little and caring less about the carrying capacity of the pavements. When the vehicle tax, the gasoline tax and any required special taxes are paid by the trucking companies, they are still far ahead of the game. The sums they pay into the state treasuries are only a drop in the bucket compared to the benefits derived and the damage done.

It is estimated that less than 2 per cent of the vehicles using our paved highways weigh more than 5 tons. It would manifestly be a wasteful procedure to build thicker and more heavily reinforced concrete pavements to carry this 2 per cent of commercially owned traffic. True economy calls for a reasonable limit on wheel loads and total loads, to prevent damage to the highway pavements now in existence. Definite means must also be provided for enforcing the limits established.

Unless something of this kind is done, the taxpayer who pays for our highways will not only be crowded off the roads, but he will be asked to rebuild them for the further use of the transportation companies that broke them up. Taxpayers have been known to go on strike by voting against bond issues, even under less provocation than this.

Engineers and other state highway officials are represented by various organizations. The time is here for a nation-wide movement, sponsored by one or more of those organizations, to establish uniform and reasonable load regulations for motor trucks using highways, and to devise methods for enforcing the regulations.

Where the Future Market Lies

THE Lincoln Tower, a 23-story bank and office building now approaching completion in Fort Wayne, Ind., utilizes 100,000 light-weight concrete units of standard size in the back-up of the exterior walls.

St. Anthony's Church, in Kenosha, Wis., required 40,000 similar units. The Haddon Hall Hotel, built in Atlantic City in 1929, contains 500,000 light-weight units in fireproofing and back-up work.

These are random examples of the kind of buildings that hold the future market for aggressive manufacturers of concrete masonry units.

Opportunities in Airport Construction

AIRPORTS promise to become one of the major items in the field of concrete construction.

Appropriations and authorized bond issues made available for construction and improvements during 1930 at eighty public airports in American cities total $67,000,000. It is estimated that no less than $100,000,000 will be expended in new construction in airports during this year.

Not all of this construction will involve concrete work, but every airport of any consequence requires concrete for runways, for floors of hangars and other buildings, and for miscellaneous construction.

With about 2,000 airports in service in the United States, and with the number steadily increasing, construction companies and smaller contractors may exploit this field to their advantage.

When Comparisons Become Favorable

JUNE has the distinction of being the first month this year to show a greater value of actual contracts awarded than in the corresponding month of last year. The increase, moreover, is a substantial amount—more than ten per cent in the 37 states covered by the Dodge reports.

Since the first of January we have heard much of that phrase "compared with the corresponding month of last year." In a large majority of cases the comparison was unfavorable to 1930, and we were left to derive whatever consolation we could from the fact that it might have been worse.

Now the comparisons with a year ago will run into the second half of the year, and the second half of 1929 was not so far up in the clouds as the first. We may now look for a greater proportion of favorable monthly comparisons, not only in contracts awarded, but in other directions. As more and more of the comparisons turn favorable to this year, we may expect a change in our mental attitude, with a tendency to look forward instead of backward.

Current Activities of Organized Groups

Many knotty problems pertaining to cement and concrete are either in course of solution or recently completed by organized societies or smaller groups. The busy reader may keep himself informed by watching these items.

Construction Census Being Completed by Field Enumerators

THE CENSUS of construction undertaken by the Bureau of the Census of the United States Department of Commerce is now being completed by field supervisors and enumerators, who are calling on all general contractors, sub-contractors and speculative builders who have not sent in their questionnaires by mail. In addition to the first list of 140,000 contractors to whom the questionnaires were originally sent, the enumerators have found more than 40,000 who had been overlooked when the first list was compiled. Still others are being added daily.

Many of these additional names include persons and firms engaged in jobbing, repairing and remodeling, who probably have not considered themselves contractors and had not known that they were to be included in the census. Under the provisions of the law authorizing the construction census, however, each person or firm who did at least $25,000 worth of new construction or repair work in 1929 is required to make a report.

Only the consolidated figures obtained in the construction census will be made public. These will include data on wages and salaries paid, number of working days, time lost because of strikes and lockouts, investment in equipment, cost of rented equipment, office and other overhead expenses, value of contract work performed, and the quantities and kinds of various building materials used.

Tests of Plain and Reinforced Haydite Concrete

A 20-PAGE pamphlet entitled "Tests of Plain and Reinforced Haydite Concrete," by F. E. Richart and V. P. Jensen, presented at the recent annual meeting of the American Society for Testing Materials, describes current progress in a series of tests now under way at the University of Illinois. The investigation includes mixtures in which haydite is used as both the fine and coarse aggregates, and others in which natural sand is used with coarse haydite. The strengths attained compare favorably with the strengths of corresponding mixtures of stone and gravel concrete. The weight of the all-haydite concrete ranges from 93 to 106 lb. per cu. ft., depending on the richness of the mixture. The weight of the sand-haydite concrete varies from 112 to 126 lb. per cu. ft.

Change Specifications for Billet-Steel Bars

THE A. S. T. M. Standard Specifications for Billet-Steel Reinforcement Bars (A 15-14) were changed during the recent annual meeting in Atlantic City. One change eliminates Paragraph 2(a), which established the structural grade of billet-steel bars as the standard unless another grade was definitely specified. This change is expected to facilitate the more general acceptance of the intermediate grade as the standard.

A second change established 90,000 lb. per sq. in. as the upper limit of the ultimate strength of the intermediate grade, in place of the former value of 85,000 lb. Requirements for elongation are also modified, the minimum now being 16 per cent for plain bars and 14 per cent for deformed bars regardless of the ultimate strength of the steel.

Motion Pictures of Concrete Highway Construction

A TWO-REEL motion picture film of standard 35-millimeter width, entitled "Concrete Road Construction" and made by the United States Bureau of Public Roads, has been obtained by the Portland Cement Association for the use of engineering clubs and societies, contractors' meetings, business men's organizations and similar groups.

The film can be used in a standard motion picture machine and requires about 30 minutes for running. The second reel covers construction methods, inspection and testing in great detail. It is of value not only to engineers and contractors, but it serves also to impress laymen with the care employed in concrete highway construction.

Requests for the picture should be made well in advance and should be addressed to the Portland Cement Association, 33 W. Grand Avenue, Chicago.

Joint Committee Organizes

THE NEW Joint Committee on Concrete and Reinforced Concrete, sponsored by the American Society for Testing Materials, the American Concrete Institute, the American Society of Civil Engineers, the American Railway Engineering Association and the Portland Cement Association, held an organization meeting at the Haddon Hall Hotel, in Atlantic City, on June 26th during the annual meeting of the American Society for Testing Materials. The reorganized committee is charged with the revision of the Standard Specifications for Concrete and Reinforced Concrete published in 1924.

Instruction in Water-Cement Ratio Law

THE CONCRETE Reinforcing Steel Institute, Tribune Tower, Chicago, is sponsoring a number of short courses of instruction on the practical application of the water-cement ratio method of controlling the strength of concrete. It is expected that these courses will be developed to include lectures on other technical data, such as comparative costs, design of tall buildings of reinforced concrete, and related subjects.

Safety Code for Floor and Wall Openings

THE American Standards Association, whose proposed safety code for construction work was reported on this page in our July issue, now has available for distribution a tentative draft of a safety code on "Floor and Wall Openings."

Copies of this tentative code may be obtained by addressing the National Safety Council, 20 North Wacker Drive, Chicago, Ill.

Study Fourteen Standard and Four Early-Strength Cements

By C. H. SCHOLER[1] and L. H. KOENITZER[2]

Synopsis

The trend of concrete investigation in the past few years has been toward a critical study of cements and their concrete-making qualities. Such a study was undertaken last winter by the Engineering Experiment Station of the Kansas State College through its Road Materials Laboratory, the official laboratory of the Kansas Highway Commission, to determine the variations between the brands of cement in use in this territory as found in the properties that might affect their concrete-making qualities.

The properties studied were the standard chemical and physical properties, the compressive and flexural strengths in mortar and concrete, the workability or consistency as expressed by slump and flow, the water-cement ratio-strength relation for each cement through a narrow range, and the mortar voids characteristics of each of the eighteen brands of cement studied.

While certain well-defined characteristic differences seem to be brought out by this study, the general impression from the data is that of rather unusual uniformity. The data indicates that the peak of the water-cement ratio-strength relation is much broader for some brands than for others. The quantity of water required to produce maximum density (basic water content) varied but little for most of the brands studied, the maximum variation shown being 20 per cent between the high and the low values.

Introduction

THERE is a widespread interest at the present time in the study of the characteristics of cements. Committee C-1 on Cement of the American Society for Testing Materials gave a report on thirty-two brands of cements at the 1928 annual meeting of the society.[3] Only two or three of the brands of cement reported in this paper were included in the report of Committee C-1. Practically every brand of cement reported herein was used on highway construction work in Kansas during the past year. These cements were manufactured in Kansas or adjoining states and were made of materials from very similar geological formations.

The question has often been raised whether certain brands of cements have certain characteristics which make one brand more desirable than another. A study of different brands over a period of years indicates that the concrete-making qualities of each might be different. In actual paving construction work, inspectors have noted a difference in the amount of water required for different brands of cements, as well as a difference in the workability.

Materials

Cement

Three sacks of cement were received from each mill co-operating in the research. The three sacks were mixed together and placed in galvanized cans with tight-fitting lids. Chemical analyses and physical tests of the cements are given in Tables I and II.

Aggregate

The sand was secured locally from the Kansas River. It was a well-graded material with a gradation of 2.68 (fineness modulus). The coarse aggregate in this experiment was durable sandstone secured from Lincoln, Kans. The sandstone was well graded from 1½ to ¼ in. in size, weighing 89.9 lb. per cu. ft. Properties of the aggregates are recorded in Table III.

Mixing Water

The water used in mixing the concrete was secured from the Kansas State College supply, which is used for drinking purposes. The mixing water was kept at 70 deg. F. throughout the experiment.

Tests of Mortars and Concretes

Slump and Flow Tests

Two experienced concrete operators made all slump and flow-table tests. The A. S. T. M. Tentative Method of Test for Consistency of Portland - Cement Concrete (D 138-26 T) was followed in the slump tests. The flow was determined on a 28-in. aluminum table, using a truncated cone 6¾ in. in diameter at the top, 10 in. in diameter at the bottom, and 5 in. high. The table was raised ½ in. and dropped 15 times in 15 seconds. Several of the drier mixes gave a crumbling and not a flowing action. In such a case the flow was recorded as 100 (that is, no flow) for that particular mix.

The slump and flow tests of the different brands of cements show a definite relationship between slump and flow. The correlation factor was found to be 0.86, which is good.

Mortar-Void Study

A mortar-void study was made by three operators on each brand of cement. A local river sand was used. All materials were weighed in metric units on an accurate torsion balance. The mix used was 1:3½ by absolute volume, which is practically equivalent to a 1:3 mix by weight for average materials.

After the specific gravities of the different sands and cements were determined, the proportion was calculated and a mix of sufficient size for one 3 by 6-in. cylinder was made up.

The basic water content may vary as much as 3 per cent when the same operator tries to check himself later. Different operators get slightly different results, varying as much as 5 per cent of water, although they get practically the same kind of a curve for the different cements.

After the basic water content was determined, the same operator mixed up four batches of mortar for each cement, each sufficient to make ten 3 by 6-in. cylinders. The specimens were tested in an Olsen 100,000-lb. testing machine, the load being applied at the rate of 0.5 in. per minute. A special 3-in. spherical top bearing was used.

The data are presented in Table IV.

Flexure and Compression Tests of Concrete

After the basic water content of the mortar for each brand of cement was determined, a concrete mix 1:1.8:3.2

Abstract of paper presented at thirty-third annual meeting of the American Society for Testing Materials, Atlantic City, N. J., June 23rd to 27th.

[1] Professor of Applied Mechanics, Kansas State Agricultural College, and Consulting Materials Engineer, Kansas Highway Commission, Manhattan, Kans.

[2] Instructor in Applied Mechanics, Kansas State Agricultural College, Manhattan, Kans.

[3] *Proceedings*, Am. Soc. Testing Mats., Vol. 28. Part I. p. 233 (1928).

TABLE I

Chemical Analyses of Fourteen Standard Portland Cements and Four Early-Strength Cements

Each value reported is the average of two individual analyses by an experienced chemist

Brand of Cement	SiO_2, per cent	Fe_2O_3, per cent	Al_2O_3, per cent	R_2O_3, per cent	CaO, per cent	MgO, per cent	SO_3, per cent	Loss on Ignition, per cent	Insoluble Residue, per cent	$\frac{SiO_2}{R_2O_3}$	$\frac{Al_2O_3}{Fe_2O_3}$	$\frac{CaO}{SiO_2 + R_2O_3}$	3 CaO Al_2O_3,* per cent	2 CaO Fe_2O_3,† per cent	$CaSO_4$,‡ per cent
Standard Portland Cements:															
A	22.12	1.88	6.82	8.70	64.32	3.04	1.71	0.70	0.31	2.54	3.63	2.09	18.07	3.20	2.91
B	20.44	2.72	6.78	9.50	63.90	1.89	2.09	1.49	0.29	2.15	2.49	2.13	17.97	4.62	3.55
C	22.51	2.84	6.03	8.87	64.84	1.22	1.42	1.52	0.40	2.54	2.12	2.07	15.98	4.83	2.41
D	21.17	3.56	5.78	9.34	63.84	2.94	1.59	0.79	0.33	2.27	1.62	2.09	15.32	6.05	2.70
E	21.67	2.96	5.89	8.85	64.12	3.00	2.01	0.82	0.18	2.45	1.99	2.10	15.61	5.03	3.42
F	20.67	2.68	7.66	10.34	64.73	1.78	1.71	1.54	0.22	2.00	2.86	2.09	20.30	4.56	2.91
G	21.96	2.24	6.11	8.35	64.78	1.59	1.80	1.86	0.26	2.63	2.73	2.14	16.19	3.81	3.06
H	21.99	2.84	5.83	8.67	64.17	2.06	1.78	1.76	0.33	2.54	2.05	2.09	15.45	4.83	3.03
I	21.44	3.18	6.64	9.82	64.38	2.55	1.76	0.91	0.12	2.18	2.09	2.06	17.60	5.41	2.99
J	21.16	2.92	5.97	8.89	65.66	2.55	1.38	0.94	0.14	2.38	2.04	2.19	15.82	4.96	2.35
M	21.78	2.68	5.93	8.61	63.15	3.85	1.78	1.13	0.39	2.53	2.21	2.08	15.71	4.56	3.03
S	22.39	2.69	6.25	8.94	64.09	2.06	1.78	1.18	0.30	2.50	2.32	2.05	16.56	4.57	3.03
W	21.61	1.88	7.93	9.81	65.04	1.79	1.63	0.62	0.17	2.20	4.22	2.07	21.01	3.20	2.77
X	21.64	2.74	6.37	9.11	64.69	2.84	1.77	0.40	0.16	2.38	2.32	2.10	16.68	4.66	3.01
High-Early Strength Cements:															
N	7.29	16.24	33.58	50.82	37.74	1.68	0.63	1.52	5.52	0.14	2.07	0.65	——	——	2.96
P	20.18	3.42	4.75	8.17	65.92	2.61	1.74	1.23	0.24	2.47	1.39	2.33	12.59	5.81	2.96
T	17.76	2.80	9.48	12.28	65.49	1.39	2.19	1.69	0.28	1.45	3.39	2.18	25.12	4.76	3.74
Z	20.26	2.16	6.24	8.40	67.03	1.24	2.27	0.69	0.25	2.41	2.89	2.34	16.54	3.67	3.86

*2.65 × Al_2O_3 = 3 CaO Al_2O_3.
†1.70 × Fe_2O_3 = 2 CaO Fe_2O_3.
‡1.70 × SO_3 = CaSO.

TABLE II

Results of Physical Tests of Fourteen Standard Portland Cements

All tests made in accordance with A. S. T. M. Standards.
Each value reported is the average of twelve values determined by three experienced cement testers.

Brand of Cement	Time of Set (Gilmore Needle) Initial min.	sec.	Final min.	sec.	Normal Consistency, per cent of Water	Fineness per cent Passing No. 200 Sieve	Flour,[1] per cent	Specific Gravity at 70° F.	Tensile Strength 1:3 Ottawa Sand Mortar, lb. per sq. in. 7 days	28 days	Compressive Strength, 1:3 Ottawa Sand Mortar, 2 by 4-in. Cylinder, lb. per sq. in. 7 days	28 days
A	3	55	6	25	24.0	18.37	45.0	3.14	287	388	2450	3961
B	3	42	5	55	23.5	14.27	48.0	3.16	305	362	2583	3853
C	4	12	7	00	24.0	12.57	51.0	3.13	294	426	2877	4628
D	4	07	7	15	23.5	13.03	49.5	3.16	310	420	2456	4875
E	4	15	6	45	23.0	13.97	48.5	3.15	329	441	2633	4283
F	4	35	6	55	24.0	11.26	53.0	3.15	328	454	3511	4567
G	3	25	6	25	23.5	11.62	50.0	3.10	315	426	3117	4283
H	4	03	6	22	23.0	13.69	49.0	3.15	329	445	2700	3867
I	4	00	6	48	23.5	13.23	47.0	3.15	344	420	2989	4111
J	4	40	6	40	23.5	11.07	50.0	3.21	317	404	3025	3839
M	3	50	6	15	23.8	8.82	53.0	3.15	361	425	2931	4322
S	4	18	7	00	23.3	10.35	49.0	3.14	284	387	2472	3722
W	3	55	6	10	23.6	10.70	54.0	3.13	347	451	3139	4694
X	4	10	6	48	23.6	15.93	43.0	3.13	311	397	2688	4083

[1] The authors are indebted to Mr. Geoff A. Saeger, Chemical Engineer, Missouri Portland Cement Co. for the flour tests.

by volume—a typical paving mixture—was made up with an amount of water equivalent to 1.3 times the basic water content of the mortar. Two 6 by 6 by 35-in. beams were made from each brand of cement. Enough concrete for both beams was mixed in a power mixer for two minutes at 18 r.p.m. The weight per cubic foot of concrete remained very constant, which was an indication that the different water-cement ratios were given practically the same density in the specimens.

The beams were tested in a field beam testing machine perfected by the Materials Department of the Iowa State Highway Commission. Several states have one of these testing machines on each paving job. The machine is portable. It also fits into a small space, permitting it to be placed in the average field inspector's laboratory. The load is applied on the top of the beam midway between supports. One principle of this machine approaches the ideal in that the load is applied at a constant uniform rate. Water from the reservoir on top of the machine passes through a rubber hose underneath the scale beam into a bucket hooked on to the end of the scale beam. By keeping the scale beam balanced the load is applied at a uniform rate. When the specimen breaks in flexure, the scale beam drops on the rubber hose, cutting off the water supply. The load is determined by weighing the bucket and water on the end of the lever connection and multiplying by 100 (ratio of the levers). The breadth and depth of the specimen at the break is measured to the closest 0.02 in.

After the beams were tested, the ends were sawed square on a 24-in. carborundum saw run by a 30 hp. electric motor turning at the rate of 1200 r.p.m. The specimens were then capped with plaster-of-Paris and tested in compression in a 300,000-lb. Riehle testing machine.

The results of the flexure and compression tests are summarized in Table V, which gives also the water-cement ratio, slump and flow, weight per cubic foot and yield of the concretes from both standard portland cements and high-early-strength cements.

Discussion and Conclusions

The authors make no attempt to draw any conclusions from the results of the chemical analyses or their relation to the physical properties. Of the standard physical tests it will be noted that the percentage of flour follows very closely the percentage passing the No. 200 sieve.

The normal-consistency determination for these cements varied but little and the operators following the specified methods closely were able to get consistent checks. It was observed, however, that there was a very marked variation in the consistency of the standard mortars when made up with the quantity of water indicated by the normal consistency. It is the opinion of the authors that the determination of normal consistency is of doubtful value for indicating the quantity of mixing water to be used.

It will be noted that the maximum density of a mortar did not give the maximum in every case.

The tension and compression tests of the cement mortars show uniformly satisfactory results in general accord with each other.

The flexural strengths of the concrete were fairly uniform, whereas the compressive strengths showed a wide variation. Several brands of cement that gave the higher

TABLE III

Results of Physical Tests of Aggregates

	Lincoln Sandstone	Kansas River Sand
Sieve Analysis:		
Retained on ¾-in. Sieve, per cent	72	0
Retained on ⅜-in. Sieve, per cent	97	0
Retained on No. 4 Sieve, per cent	100	0
Retained on No. 8 Sieve, per cent	100	6
Retained on No. 14 Sieve, per cent	100	20
Retained on No. 28 Sieve, per cent	100	48
Retained on No. 48 Sieve, per cent	100	94
Retained on No. 100 Sieve, per cent	100	100
Gradation Factor	7.69	2.68
Weight per cubic foot, lb.	89.9	109.8
Specific Gravity	2.65	2.62
Loss by Washing, per cent	——	0
Color Test	——	Clear
French Coefficient of Wear, per cent	8.7	——
Strength ratio in tension at 28 days		160
Strength ratio in compression at 28 days		113

flexural strengths gave the lower compressive strengths.

The slump and flow tests of the mortar and the concrete show generally good agreement, with some outstanding exceptions. Cement B gave low slump and flow in the mortar tests, and high values in the concrete tests. Cement A gave much more slump and flow than did cement B, but at a low water content in the mortar. Cement B shows more workability than cement A, but not to a large extent.

Similar comments could be made on some of the other inconsistencies. The relationship between slump and flow is very good from the point of view of statistical analysis, but the authors believe that the slump test is simpler and more fool-proof and easier to make and interpret in terms of field conditions. Neither one is at all capable of measuring the finer distinctions of plasticity and workability. It has long been the authors' opinion that these factors cannot be expressed in terms of one measure.

TABLE IV

Results of Mortar-Void Studies, Showing Relationship Between Water-Cement Ratio, Density, Consistency and Strength of Mortars

Proportions: 1 part cement to 3½ parts local sand by absolute volume.
Each value is the average of five tests.

Brand of Cement	Ratio of Water Content to Basic	Water-Cement Ratio	Density	Consistency Slump, in.	Flow	Compressive Strength of 3 by 6-in. Cylinders, lb. per sq. in. 7 days	28 days
			Standard Portland Cements				
A	0.8	0.444	0.7365	0	100	2652	3800
	1.0	0.553	0.7506	0	100	3090	5158
	1.2	0.664	0.7431	0.5	147.5	2773	5070
	1.4	0.775	0.7209	6.75	217.5	2622	4783
B	0.8	0.391	0.7525	0	100	2652	3071
	1.0	0.489	0.7927	0	100	3995	5498
	1.2	0.586	0.7741	0.5	120	3636	5487
	1.4	0.684	0.7368	1	150	2571	3645
C	0.8	0.435	0.7647	0	100	3616	4199
	1.0	0.540	0.7836	0	100	4004	5617
	1.2	0.648	0.7522	2	190	3557	5523
	1.4	0.756	0.7290	5.5	210	2838	5325
D	0.8	0.433	0.7565	0	100	3178	4116
	1.0	0.540	0.7807	0	100	3626	5165
	1.2	0.648	0.7589	1	170	3586	5443
	1.4	0.754	0.7298	6.5	202.5	2563	4802
E	0.8	0.407	0.7428	0	100	2870	3007
	1.0	0.508	0.7741	0.063	100	3675	4251
	1.2	0.610	0.7596	0.5	137.5	3458	4676
	1.4	0.712	0.7331	2.75	195	2987	4720
F	0.8	0.392	0.7431	0	100	2718	3463
	1.0	0.484	0.7461	0	100	3227	3982
	1.2	0.586	0.7678	0.625	130	4848	5377
	1.4	0.683	0.7460	6.5	197.5	4295	5326
G	0.8	0.434	0.7506	0	100	3073	3185
	1.0	0.540	0.7704	0	100	3177	4951
	1.2	0.648	0.7502	0.5	150	2822	5055
	1.4	0.754	0.7300	7	210	2690	4837
H	0.8	0.450	0.7322	0	100	2460	3240
	1.0	0.562	0.7607	0	100	2964	4197
	1.2	0.675	0.7366	2	150	2724	4850
	1.4	0.787	0.7202	8.5	230	2101	3593
I	0.8	0.444	0.7336	0	100	2977	3662
	1.0	0.553	0.7592	0	100	3452	5139
	1.2	0.664	0.7399	1.25	165	3528	5170
	1.4	0.775	0.7248	7.75	250	3132	5277
J	0.8	0.434	0.7371	0	100	3001	3422
	1.0	0.540	0.7675	0	100	3472	4977
	1.2	0.648	0.7398	1.375	182.5	3202	4573
	1.4	0.754	0.7320	2	202.5	2912	4568
M	0.8	0.407	0.7300	0	100	2540	2722
	1.0	0.508	0.7657	0	100	3377	4715
	1.2	0.611	0.7524	1	145	3743	4949
	1.4	0.712	0.7363	6.5	205	3392	5129
S	0.8	0.411	0.7213	0	100	2353	2506
	1.0	0.514	0.7593	0	100	3399	4013
	1.2	0.617	0.7536	0.5	130	3505	4570
	1.4	0.720	0.7323	6	200	2812	4659
W	0.8	0.434	0.7594	0	100	1998	3107
	1.0	0.540	0.7713	0	100	4618	5871
	1.2	0.648	0.7560	1	144	4932	6187
	1.4	0.754	0.7348	8.5	237.5	3924	5846
X	0.8	0.411	0.7146	0	100	2230	2433
	1.0	0.514	0.7593	0	100	3218	3932
	1.2	0.617	0.7480	0.75	141.25	2911	4180
	1.4	0.720	0.7365	6.5	210	2832	4495
			Early-Strength Cements				
N	0.8	0.414	0.7422	0	100	3626	3746
	1.0	0.514	0.7802	0	100	5870	6348
	1.2	0.617	0.7653	2	167.5	6157	6901
	1.4	0.720	0.7522	8.5	256.2	5920	7205
P	0.8	0.401	0.7365	0	100	2147	2679
	1.0	0.502	0.7652	0.125	100	2779	4045
	1.2	0.602	0.7563	0.375	136.2	2440	3860
	1.4	0.702	0.7380	Not recorded		1600	2742
T	0.8	0.401	0.7370	0	100	2439	2441
	1.0	0.502	0.7801	0	100	3328	3727
	1.2	0.602	0.7649	0.875	142.5	2738	3291
	1.4	0.702	0.7352	4.5	210	2025	2966
Z	0.8	0.416	0.7338	0	100	2549	3489
	1.0	0.527	0.7812	0.125	115	3419	4832
	1.2	0.633	0.7517	2.25	187.5	1917	4994
	1.4	0.738	0.7349	8.5	252.5	1405	3290

TABLE V

Results of Tests of Concrete

Proportions: 1:1.8:3.2 by volume.
Values of modulus of rupture are the average of two tests.
Values of compressive strengths are the average of four tests.

Brand of Cement	Water-Cement Ratio	Slump, in.	Flow	Weight, lb. per cu. ft.	Yield, bbl.	Modulus of Rupture, lb. per sq. in. 7 days	28 days	Compressive Strength at 28 Days, lb. per sq. in.
			Standard Portland Cements					
A	0.689	1	120	150.4	1.610	441	600	4611
B	0.625	4.75	170	148.6	1.576	458	604	3701
C	0.693	3.5	130	149.6	1.607	513	637	4957
D	0.693	3.5	155	151.0	1.620	468	552	4243
E	0.693	1	137.5	148.4	1.594	563	675	3694
F	0.639	1.25	110	150.6	1.626	525	626	4604
G	0.734	1.5	115	149.0	1.595	457	572	4245
H	0.725	3	120	145.4	1.557	359	532	3556
I	0.734	5.375	140	150.0	1.605	437	571	3889
J	0.697	1.75	120	149.6	1.605	452	607	4333
M	0.655	2	140	148.4	1.600	458	587	4278
S	0.663	3	125	151.4	1.627	497	622	4042
W	0.693	2	140	148.0	1.590	538	613	3772
X	0.663	2.75	135	148.8	1.603	474	557	3384
			Early-Strength Cements					
						24-hr.	48-hr.	
N	0.663	3	130	149	1.606	639	751	6143
	0.700	6	135	150.2	——	615	578	4555*
P	0.686	1.5	125	148.2	1.593	334	493	4516
	0.700	4	185	146	——	283	439	4144*
T	0.698	2	125	150	1.618	402	612	5364
	0.700	3.5	155	148.8	——	302	460	4578*
Z	0.670	2.25	135	149.2	1.605	370	602	4552
	0.700	3.5	150	149	——	230	497	4552*

*Compressive strength at 14 days.

The chief variation in the various brands studied seem to be their sensitivity to small variation in water content in the mortar mixes at basic water content and above. Some cements showed in this investigation but little loss in strength with added water content, while others show a very sharp decline in strength.

The concrete tests of a typical paving mixture gave satisfactory results in every case. The water content chosen was 1.3 times the basic value given by the mortar tests. The resulting concrete showed a wide variation in workability as measured by the slump and flow tests. The mortar voids characteristics were determined for a mix 1:3.5 by absolute volume. Had this determination been made upon a mix more nearly fitting the mortar used in the paving mixture, it is probable that a more uniform consistency would have been secured. The flexure test gave satisfactory values in every case, with a maximum variation between high and low values of about 26 per cent. The compressive strength of the same concrete (tests of beam ends) varied by 47 per cent between high and low values, with the beams strongest in flexure showing in some cases the lower values in compression.

In spite of the rather wide variations that are shown in some instances, the uniformly satisfactory values given are very interesting. Wide as the variations are, they are no greater than would be found between an equal number of laboratories working on identical samples. It is the authors' judgment that until laboratory and field technique has been developed much more thoroughly than at present, the engineering profession is not in a position to discriminate very closely between brands of cement as similar in their properties as those covered in this investigation.

The authors have restricted their conclusions to the standard portland cements. Of the early-strength cements, three were portland cements and one was a high-alumina cement. The early-strength cements seemed to be more plastic and workable than the normal portland cements.

Big Increase in Contracts Awarded in June

June is First Month to Show Increase Over Corresponding Month of 1929—Contemplated Construction and Concrete Road Contracts Also Higher

June holds the distinction of being the first month in 1930 to show an increase in construction contracts compared with the corresponding month of 1929. While several previous months have reported a greater volume of contracts for public works and public utilities, the lag in contracts for buildings was more than enough to pull the total below a year ago. June contracts were much greater than any other month this year.

The following figures are reported by the F. W. Dodge Corporation as representing contracts awarded in June and in the first six months of the year:

CONTRACTS AWARDED IN JUNE

	1929	1930
Buildings	$425,050,000	$348,657,600
Public works and public utilities	120,841,100	251,915,800
	$545,891,100	$600,573,400

For the first six months of the year the total contracts amounted to $2,638,013,300, compared with $3,031,806,800 in the first six months of 1929.

Contemplated Construction

Contemplated construction work reported by the F. W. Dodge Corporation amounted to $763,216,100 in June, compared with $643,405,900 in May and $634,073,400 in June, 1929. Consequently in work contemplated as well as in actual awards June is the outstanding month of the year.

Pavement Awards Well Above Last Year

Contracts awarded for concrete pavements totaled 18,155,637 sq. yds. in June, compared with 16,421,447 sq. yds. in June, 1929, according to figures compiled by the Portland Cement Association. For the first six months the contracts for concrete pavements reached the following totals:

SQUARE YARDS OF CONCRETE PAVEMENTS AWARDED

	In First Six Months of Year	
	1929	1930
Roads	50,846,714	64,991,887
Streets	20,999,510	16,675,788
Alleys	1,635,858	1,152,998
Totals	73,482,082	82,820,673

It is said that the unwillingness of taxpayers to approve new bond issues is in large part responsible for the lag in street and alley pavements.

National Ready-Mixed Concrete Association Established

Minimum Staff at Start—Association's Headquarters at Pittsburgh—Organization Committee Report in Full

The National Ready-Mixed Concrete Association took definite form at the final organization meeting held at the William Penn Hotel, Pittsburgh, Pa., on July 10th. A plan of organization was adopted, the method of functioning determined, and officers elected at that time. About 60 persons attended.

The morning session was devoted to acceptance of the committee on organization's report. The latter provides that at the beginning the staff shall be limited to an assistant secretary working under the immediate direction of the president of the association, and that the co-operation of other national trade organizations whose work involves ready-mixed concrete shall be secured.

Other paragraphs provide that the membership shall be divided into two groups—members and associate members—as classified at the previous meeting at Chicago, and that the officers of the association shall consist of the president, three regional vice-presidents, a secretary, and a treasurer. They, with the addition of one member at large, constitute the executive committee.

Discussion of the problems common to all operators occupied the afternoon session.

The following officers were elected: J. E. Burke, Pittsburgh, Pa., president; C. M. Cornell, Boston, Mass., eastern vice-president; H. F. Thompson, St. Louis, Mo., western vice-president; R. B. Young, Toronto, Canada, Canadian vice-president; John C. Eakin, Little Rock, Ark., secretary, and J. L. Shiely, St. Paul, Minn., treasurer.

Appointment was also made of a committee to draw up a constitution and by-laws.

The report of the committee as adopted, was as follows:

1.—That the name of our organization should be The National Ready-Mixed Concrete Association.

2.—That its purpose shall be to promote the welfare and best interests of those engaged in the manufacture and sale of ready-mixed concrete.

3.—That the membership shall be divided into two groups: Members and Associate Members, as classified at their Chicago meeting.

4.—That the officers of the association shall consist of a President, three regional Vice-Presidents, a Secretary, and a Treasurer.

5.—That the officers of the association shall constitute, with the addition of one member at large, the Executive Committee of this Association. The member at large shall be chosen by the Executive Committee.

6.—That the Executive Committee of the National Ready-Mixed Concrete Association is directed to request the co-operation of those national trade associations whose work involves the ready-mixed concrete industry in any degree.

7.—That the direction of the activities of this association shall be vested in the Executive Committee.

8.—That the headquarters of the Association shall be located in the same city as the President until such time as the Association shall employ a full-time executive officer. When such officer is employed, the permanent headquarters of the Association shall be selected by the Executive Committee.

9.—That a committee shall be appointed at this meeting, consisting of a chairman and two members, to draw up a constitution and by-laws for the Association.

10.—That the staff of the Association at this time shall consist of an Assistant Secretary, who shall work under the direction of the President.

11.—That the Executive Committee shall be authorized to make such disbursements as are necessary and to incur such obligations to fulfill the recommendations of this report.

New Jersey Authorizes Highway Commission to Build Sidewalks

Act. No. 74, New Jersey Laws of 1930, authorizes New Jersey's state highway commission to build sidewalks along state highways. Two other states, Delaware and West Virginia, have similar provisions in state laws. Only about a third of the states have provisions for permitting towns and counties to build country walkways even at their own expense.

How to Save in Concrete Form Work

Concreting Exterior Panel Walls Separately—Method of Supporting Column Forms — Details Illustrated Applicable to Flat Slab Building Construction

VIII—Forms for Panel Walls and Spandrel Beams

By A. B. MacMILLAN
Chief Engineer, Aberthaw Company, Boston, Mass.

THIS article deals with forms for exterior panel walls and spandrel, or upturned, beams between columns or pilasters in buildings of skeleton construction. Specifically, the details illustrated in Figures 43, 44 and 45 are applicable to a reinforced concrete building of flat slab construction.

Thin Panel Walls

Figure 43 illustrates the case where a comparatively thin panel wall of reinforced concrete occupies the entire space between wall columns or pilasters, and between the floor slab and the wall girder supporting the floor above. This panel wall may contain windows, in which event the false window frames are set in place as described for monolithic concrete walls in the July installment of this series and illustrated in Figures 41 and 42.

Flat Slab Building Walls

Figures 44 and 45 apply to the case where the window frames in the wall of a flat slab reinforced concrete building occupy the entire space between wall columns or pilasters, and between the window sills and the underside of the floor slab above. This leaves only the spandrel (or upturned) beam between the floor and the window sill to be concreted, since the remaining part of the wall panel is occupied by the window frame. This is a common type of building for industrial and commercial uses, in which the greatest possible amount of window space is to be provided.

Panel Wall Form Work

A panel wall is ordinarily supported on a reinforced concrete wall girder that comprises a part of the structural frame of the building. Such a girder is shown clearly in the cross-section in Figure 43, where it is seen to have been concreted along with the floor slab which it helps to support.

Holding the Wall Forms in Position

A stub wall, shown most clearly in the cross-section in Figure 43, is concreted at the time the wall girder and floor slabs are concreted. The purpose of this stub is that of holding the panel wall forms in position at the bottom. A key left in the top of the stub helps to unite it with the fresh concrete placed upon it.

At the top the panel wall forms are held in alignment by U-shaped yokes, referred to as "loose yokes" in the cross-section and the upper plan in Figure 43, and shown in sufficient detail there. Wedges or blocks are inserted between the yokes and the face of the column or pilaster to adjust the form work horizontally.

The inner and outer panel wall forms are held in proper relation to each other by spreaders and tie bolts and a pair of 3-by-4 waling timbers at the top. At the bottom, just above the stub wall, there is another pair of waling timbers, or rangers, made either of single 3-by-4's or of two 1-by-6's or two 2-by-6's. These walers, or rangers, either at top or bottom, may be made either of single 3-by-4's, or of lighter timbers used double, depending on the material available.

Similarly, the spreaders may be either wooden or concrete spreaders, as illustrated in Figure 38 in the July installment; and the tie bolts are passed either through the concrete spreaders, or through tin sleeves if wooden spreaders are used.

Panel Wall Concreted Separately

Observe that the panel wall for which form work is shown in Figure 43 is to be concreted after the floor slab and the structural frame, consisting of columns and wall girders, is concreted and forms are removed. The keys left in the columns and in the stub wall serve as anchors to hold the panel walls in place after all form work is taken down.

When the panel walls are to be continuous with the structural frame, the wall form work must of course be built at the time the column forms are built, so that walls and columns may be concreted at the same time. In this event the details given in Figures 39 and 40 should be followed. (See the July installment of these articles.)

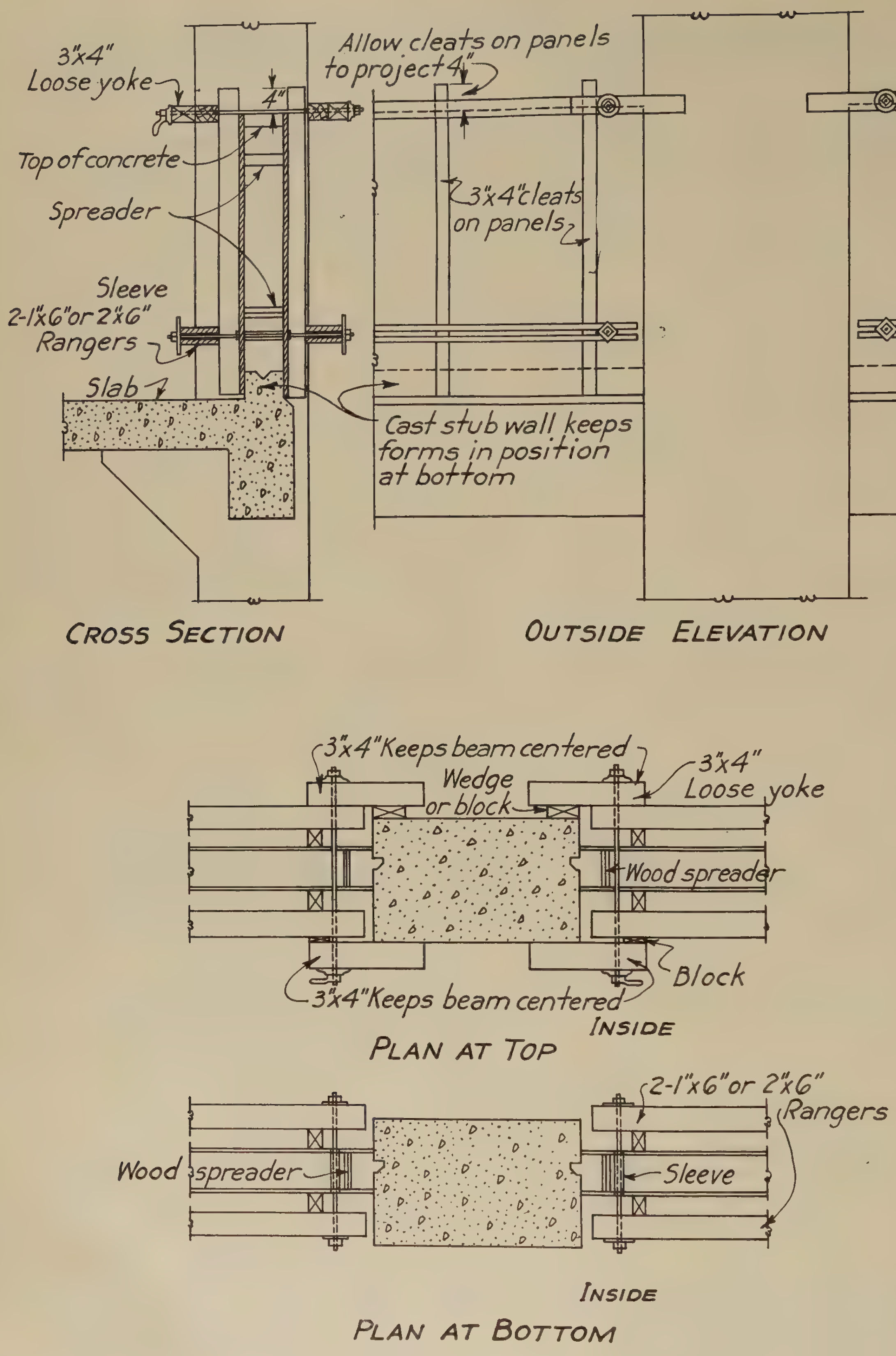
Spandrel Wall or Upturned Beam

A spandrel wall, or upturned beam, is essentially a wall girder and comprises a part of the structural frame of a building. For that reason it must be concreted at the time the wall columns or pilasters are concreted, and must be continuous with them and with the floor slab, This wall, or beam, it may be repeated here, extends from the floor slab to the window sill, the rest of the wall space between columns and between floors being occupied by windows.

Figure 44 contains the details of the form work for the spandrel or upturned wall beam itself, while Figure 45 shows how this form work is connected up with the form work for the wall column or pilaster.

Large Window Area

These details, as previously mentioned, are applicable



CROSS SECTION

OUTSIDE ELEVATION

PLAN AT TOP

PLAN AT BOTTOM

FIGURE 43- PANEL WALL FORM DETAILS

to a building of the flat-slab type of reinforced concrete construction in which the window area is to be as large as possible. Since the window extends up to the underside of the floor slab, the wall space immediately above, between the floor slab and the window sill, must serve both as a wall and as a girder.

Since the spandrel or upturned beam is to be continuous with the floor slab, the inner panel of the form work must be left open and unobstructed where the slab occurs. Here the form work is supported on small precast blocks of concrete whose height is equal to the depth of the slab, these blocks being left in place.

Stub Column to Support Column Forms

The isometric view in Figure 45 should be studied in connection with Figures 15 and 16, in the March installment of these articles. Observe how the pilaster or column form assembly shown in Figure 45 extends but slightly above the wall beam. This, when concreted, forms a base, or stub column, which serves to secure and support the form work for the column immediately above it. This is shown most clearly in Figure 15, in which the horizontal dotted line about on a level with the top of the "Ell" block represents the top of the column stub. The bolt for the "Ell" block must of course be set in place in the pilaster or column form assembly shown in Figure 45.

Haunch Provision

No provision is made in Figure 45 for a column haunch such as the one at the top of the wall column in Figure 15. If plans call for a haunch, provision must be made for it in the form work, in the manner shown in Figure 15, and to some extent in Figures 14 and 18.

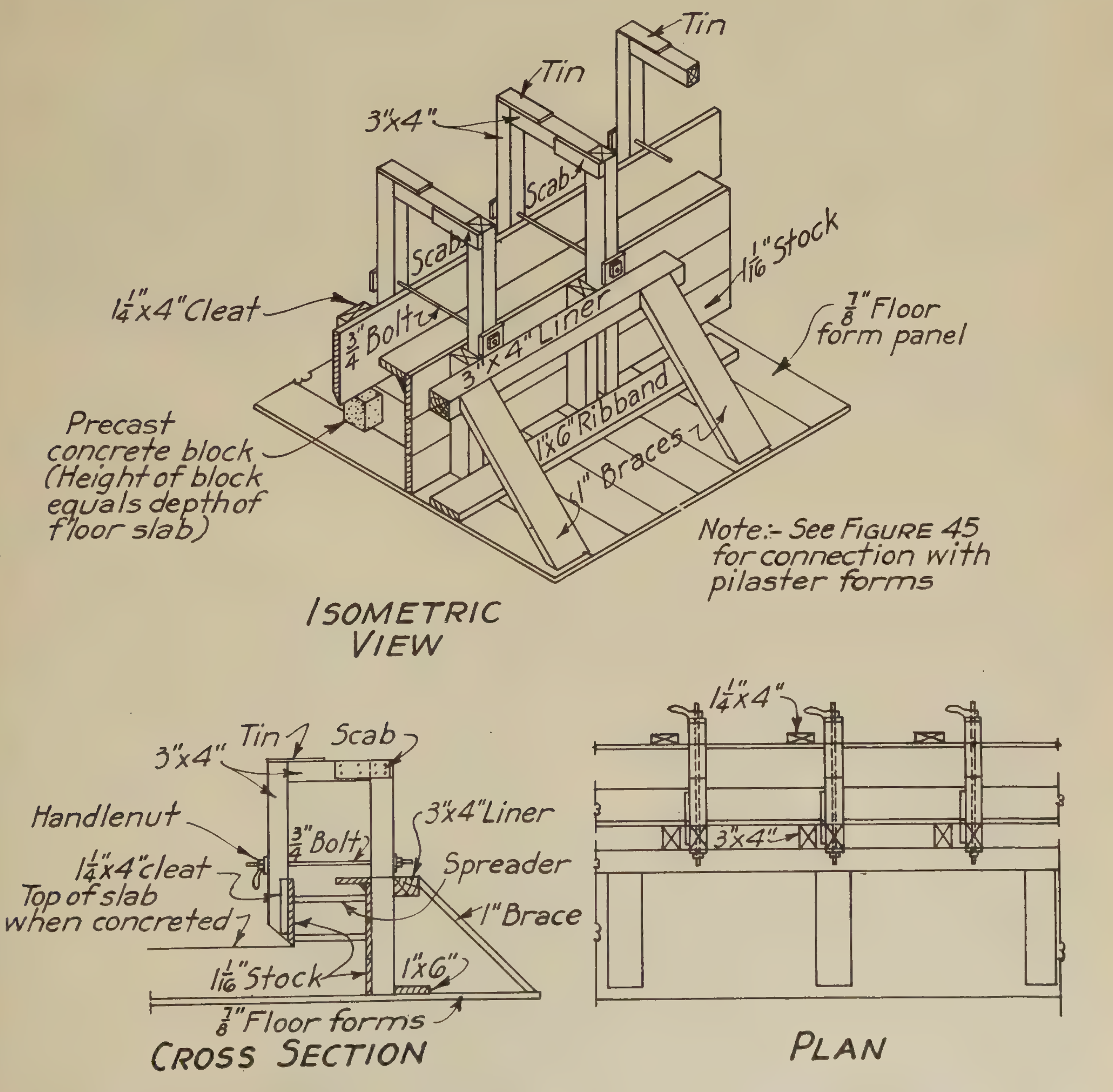
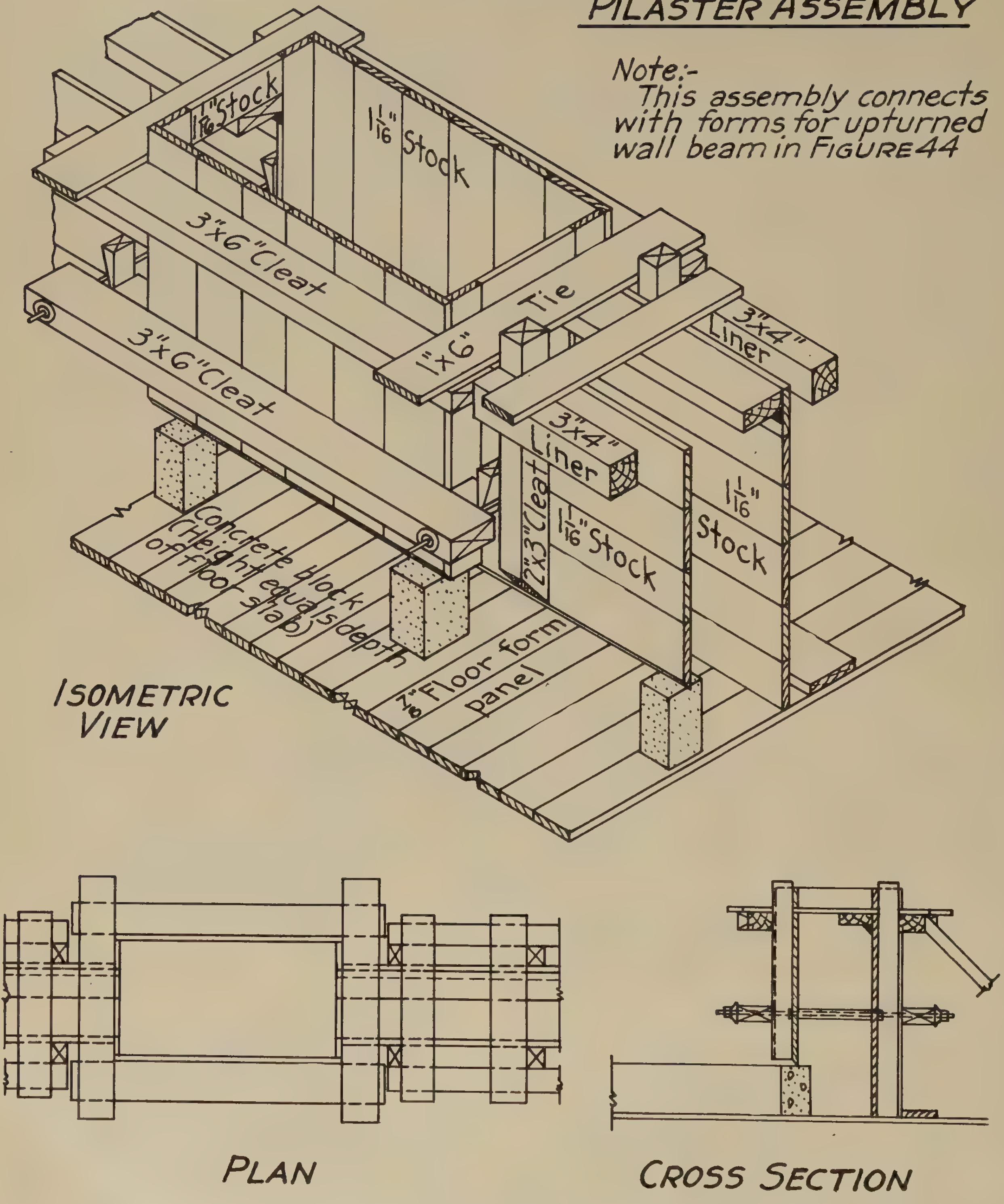


Figure 44—Forms for Spandrel or Upturned Wall Beam

FIGURE 45 - FORMS FOR PILASTER ASSEMBLY



Note:- This assembly connects with forms for upturned wall beam in FIGURE 44

Fire Prevention Week October 5 to 11

Fire prevention week for 1930 has been set for the week from October 5th to 11th, inclusive. The National Fire Protection Association, 60 Batterymarch Street, Boston, announces the forthcoming publication of a poster and other campaign material expected to be available for distribution in August.

"Successful Piece-Work Pay System" —Correction

A major part of the piece-work schedule given in the article "Successful Piece-Work Pay System in Concrete Products Plant," in the June issue, was inadvertently printed as on an hourly basis. "Per Hundred" was meant instead of "Per Hour."

Restoring Old Buildings at William and Mary College

Concrete and Steel Used Extensively in Reconstruction and Remodeling—Oldest Building Now Has Floors and Roof Supported by Modern Structural Frame-Work—Original Foundations and Exterior Walls Preserved

AS a part of the plan for reconstructing historic Williamsburg, Va., several of the older buildings of William and Mary College are being restored or remodeled. The work includes, notably, the restoration of the first building erected at this famous college, known as the Wren Building and also as the main building.

Library Building of William and Mary College, built in 1907 and recently enlarged

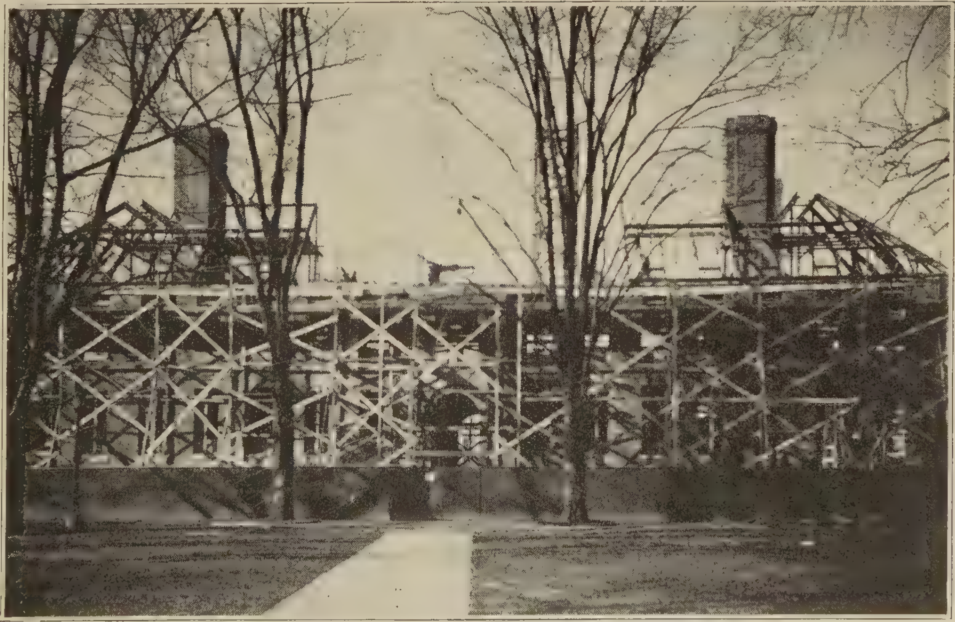
John D. Rockefeller, Jr., has undertaken the reconstruction and restoration of a number of old colonial buildings and other historic features of Williamsburg. Only one of the college buildings, however, was included in his reconstruction schedule. In consequence, alumni and friends of the college raised a fund, supplemented by a donation from the State of Virginia, to remodel or enlarge others of the older buildings. The library is one of the structures that was enlarged out of this fund.

Restoring the Oldest Building

Construction of the oldest of the college buildings, named after Sir Christopher Wren, the famous British architect who designed it, was started in 1695 and completed in 1698. The building was destroyed by fire in 1705, but the masonry foundations and walls remained standing. Reconstruction of the roof and the interior was completed in 1716. In 1859 the building was again destroyed by fire, but again the foundations and walls remained standing. The structure was rebuilt immediately on the original foundations and walls. During the Civil war the building was fired by federal soldiers, and was again seriously damaged but not destroyed.

The Present Reconstruction

In the present reconstruction of the Wren building, known also as the main building, the plan employed is in line with the modern construction methods followed in many similar instances where the outside walls and the general exterior appearance of old buildings are to be preserved. That is, the new roof and the new floors are supported on a structural framework of concrete and steel, the framework in turn being supported on its own foundations. The floors are made fireproof with rein-



The Wren Building at William and Mary College in process of reconstruction. The new roof and floors are supported on a new and independent framework of concrete and steel. The original exterior walls and foundations are preserved as built in 1695 to 1698 forced concrete construction in the structural parts. With this method of reconstruction the old exterior walls, though firmly anchored into the new construction, are relieved of their former function as bearing walls, and have only their own weight to support. In exterior details and appearance the building will, of course, remain as originally built.

The contract for the reconstruction of the Wren building was awarded to Todd & Brown, Inc., 420 Lexington Ave., New York City. Concrete to the amount of some 1,500 cu. yds. was used in this building alone. Extreme care was taken to insure the best possible workmanship. The highest quality of fine and coarse aggregates obtainable was used in making the concrete, and the cement was delivered in heavy paper bags and kept in well-sheltered storage until it was used.

Enlarging the Library

The contract for enlarging the library building was awarded to the Farmville Manufacturing Co., of Farmville, Va., with H. B. Onion as superintendent of construction. While the work on this building involved enlarging and remodeling rather than reconstruction, the fact remains that the contract required about 500 cu. yds. of concrete.

Much of the concrete had to be deposited in locations that were almost inaccessible; but here, as in the Wren building, only concrete materials of the best quality were used, proportioning was carefully made, the mixing was thorough, and cement was kept stored under shelter in paper bags until it was used.

What British Building Research Board Is Doing

Rapid and economical laboratory testing is one of the purposes of the government organization for building research set up by the British Department of Scientific and Industrial Research. It was expanded in 1925 to enable a more comprehensive program of work to be undertaken.

The new Building Research Station is located in a converted country house at Garston, near Watford, Herts, England. In the main building are the offices, library and records, physics laboratories, chemical laboratories, drawing office, photography rooms, etc. An old stable block has been converted into a chemical laboratory, cement-mixing room and stone-grinding room. In the small greenhouse is a carborundum saw for cutting concrete. Behind the stable block is a new building comprising the engineering testing laboratory, etc. In this are several testing machines, including a 500-ton Amsler crushing machine. Behind this block is a building used as a special investigation laboratory. The furnace room, power house, and refrigerating room are near this building. There is also a constant temperature laboratory, in which a number of tests are now in progress.

The work of the station is divided into two main subdivisions: (1) general research and (2) intelligence and special investigations. The general research section is endeavoring to ascertain the fundamental properties of building materials and, for example, to devise quick weathering tests, etc., while the special investigations section applies the information as obtained to the solution of special problems submitted by various inquirers. Often, when complete information is unavailable, special researches are initiated for the purpose of obtaining at any rate a partial solution.

The most important group of building materials dealt with at the station is the quasi-solid group, which includes cements, limes and many natural rocks. The information gained is of special value as materials in this group vary with the external humidity conditions. It is found that when the moisture content increases there is a loss of strength, a drop in the value of Young's modulus of elasticity, and an increase in volume.

With regard to concretes, routine tests are being carried out, for ages up to twenty years, for various cements, with different aggregates, methods of curing and storing, etc. The action of sea-water is being investigated and the use of pozzolanas in this connection is being studied.

As with mortars and neat cement pastes, an effort has been made to standardize test conditions for concrete. One of the difficulties is to determine the amount of water required. Different cements require different amounts for maximum strength and the water used for mixing has a considerable effect upon the ultimate strength. The method of testing concrete in compression is also being studied. It is perhaps not realized how unsatisfactory is a compression test result. What does the result signify? The stresses in the test piece are very complex owing to the restriction at the ends and the concentration of stress round the periphery of the end faces. The apparent strength varies considerably with the nature of the end packing, as the following figures for a 1:2:4 concrete show: —

Packing	Apparent Strength lb./sq. in.
Plywood	2,268
Millboard	2,032
Steel plates (polished)	1,860
Ruberoid	1,628

With regard to reinforced concrete, the phenomena of adhesion and bond strength are being studied and a special extensometer has been devised for measuring the changes in length of embedded steel—not only of the overall length, but also of intermediate portions—so that the distribution of stress along the bars can be determined from the time of making the specimen. In one test the stresses imposed on the steel due to the initial shrinkage of the concrete were as much as 6,000 lbs./sq. in. The results to date show that there are appreciable differences in the stresses induced in the steel when different cements, such as aluminous and portland, are used.

The investigators at the station realize the great importance of standardization and to this end they are co-operating with the British Engineering Standards Association in the preparation of standard specifications. This includes work for the latter body's sectional committees on cements and building materials, and for the sub-committees and panels dealing with asbestos cement roofing, slates and tile, portland cement, portland blast furnace cement, lime, etc. As soon as the question of standardizing several of these products was approached, the lack of relevant scientific data and the need for thorough investigation of the materials became apparent. Work on problems that have arisen in this way is now proceeding at the station.

The use of clinkers for concrete work is being adopted widely, but there have been numerous failures. An investigation into these failures is in hand, and some of them appear to be due chiefly to the presence of unburnt coal. Only certain coals are dangerous, apparently those which combine readily with oxygen. A rapid and easy test for the soundness of clinkers is being sought.

Proposed Recommended Practice for
Heavy Duty Floor Finish

Balance of Report of American Concrete Institute Committee 802 Gives Specifications for Heavy Duty Floor Finish, Supplemented by Notes on Light Duty Finish

THESE specifications on floor finish complete the publication of the report of the A. C. I. committee headed by John G. Ahlers.

Two abstracted articles, published in the May and June issues, recommended drastic changes from prevalent practice and illustrated proper procedure.

1—Base Slab

The surface of the structural base slab shall be finished reasonably true and struck off at a level approximately one inch below the required finish grade.

As soon as the condition of the concrete base permits, and before it has fully hardened, all dirt, laitance and loose aggregate shall be removed from the surface with a wire broom, which shall leave the coarse aggregate slightly exposed, or the surface otherwise roughened to improve bond with the topping.

When it is impossible to remove laitance and roughen the slab by brooming, the surface shall be cleaned and prepared for bond by chipping after the base has hardened.

Just prior to placing the finish, the base slab shall be thoroughly cleaned by scrubbing, to the satisfaction of the engineer.

(*Note*: Notes appearing after Articles 2, 3, 5 and 6 pertain to wearing courses that are to be finished by grinding. Each note provides the basis of revision of the paragraph preceding it when considering the finish of floors by grinding.)

2—Aggregates

Both fine and coarse aggregates shall be used in the finish. Fine aggregate shall consist of clean, hard sand or crushed stone screening free from dust, clay, loam or vegetable matter. All particles shall pass a ¼-inch sieve and shall be graded from fine to coarse with the coarse particles predominating. Not more than 3 per cent shall pass a 100 mesh, and not more than 10 per cent shall pass a 50 mesh sieve.

Coarse aggregate shall consist of clean, hard pea gravel, or crushed stone, free from dust, clay, loam or vegetable matter and from coatings which will tend to weaken the bond. It shall contain no soft, flat or elongated fragments, and shall be graded from ¼ to ⅜-in.

Note: For light duty floor finish the coarse aggregate shall be graded from ⅛ to ¼-in. (passing a ¼-in. screen but retained in a ⅛-in. screen).

All aggregate shall be selected with care. Coarse aggregate shall be of an approved character, and samples of proposed material shall be submitted to the engineer for approval prior to use.

Note: When the topping is to be finished by grinding, the coarse aggregate shall be hard, tough, crushed stone graded as recommended for terrazzo.

3—Mixture

The mixture shall be 1 part portland cement, 1 part fine aggregate and 2 parts coarse aggregate by volume. This nominal mix may be slightly varied, depending upon the local conditions, and as the engineer may direct. If the aggregate is very coarse, the gravel or stone should be reduced to 1½ parts. In no case shall the volume of the coarse material be more than twice the volume of the fine.

The mixture shall be determined by the engineer and once established shall not be changed except upon his written order.

Not more than 5 gallons of mixing water including the moisture in the aggregates shall be used for each sack of portland cement in the mixture.

Note: When the topping is to be finished by grinding, no sand shall be used. One part of cement by volume shall be mixed with 3 parts crushed stone.

4—Consistency

The concrete shall be of the driest consistency possible to work with a sawing motion of the strike-off board, or straightedge. Changes in consistency shall be obtained by adjusting the proportions of fine and coarse aggregate within the limits specified. In no case shall the specified amount of mixing water be exceeded.

5—Placing and Compacting

The base slab shall be thoroughly wetted just prior to the placing of the finish, but there shall be no pools of water left standing on the wetted surface. A thin coat of neat cement grout shall be broomed into the surface of the slab for a short distance ahead of the topping. The wearing course shall be applied immediately before the grout has hardened, and brought to the established grade with a straightedge.

Note: When the surface is to be finished by grinding, the wearing course shall be compacted with rollers or vibrators. Rollers shall be of sufficient weight to compact the concrete thoroughly. When the engineer may direct, coarse aggregate shall be uniformly scattered over the surface while rolling is in progress.

5a—Placing and Compacting (Light Duty Floor Finish)[1]

The concrete topping shall be deposited on the base within 45 minutes after the concrete base is in place and before the base has appreciably hardened.

6—Finishing by Troweling

After striking off the wearing course to the established grade, it shall be compacted with a wood float. The surface shall be tested with a straightedge to detect high and low spots which shall be eliminated. Floating shall be followed by steel troweling after the concrete has hardened sufficiently to prevent excess fine material from working to the surface. The finish shall be brought to a smooth surface free from defects and blemishes. No dry cement or a mixture of dry cement and sand shall be sprinkled directly on the surface of the wearing course to absorb moisture or to stiffen the mix. After the concrete has further hardened additional troweling may be required. This shall be done as may be directed by the engineer.

Note: Surfaces to be finished by grinding shall be swept with soft brooms after rolling to remove any water and surplus cement paste that may be brought to the surface. The wearing course shall then be floated and once lightly troweled, but no attempt shall be made to remove all trowel marks.

7—Finishing by Grinding

After the wearing course has hardened sufficiently to prevent dislodgment of aggregate particles, it shall be ground down with an approved type of grinding machine shod with free, rapid cutting carborundum stones to expose the coarse aggregate. The floor shall be kept wet during the grinding process. All material ground off shall be removed with a squeegee and the floor shall be flushed with water.

Air holes, pits and other blemishes shall then be filled with a thin grout composed of one part of No. 80 grain carborundum grit and one part of portland cement. This grout shall be spread over the surface and worked into the pits with a steel straightedge, after which the grout shall be rubbed into the floor surface with the grinding machine.

After all patch fillers have hardened for seven days the floor surface shall receive a second or final grinding to remove the film and to give the finish a polish. It shall then be thoroughly washed and all surplus material removed.

7a—Finishing by Grinding (Light Duty Floor Finish)[2]

This paragraph to be used in lieu of paragraph 6 when finish by grinding is desired.

After the topping is struck off to a true and even surface it shall be thoroughly compacted with a wood float until all depressions and irregularities are eliminated. The surface shall then be once lightly troweled and allowed to harden. During the hardening period the surface shall be protected as required in Article 8.

---

[1] Use paragraph 5a in lieu of 5 for light duty floor finish.

[2] Use paragraph 7a in lieu of 7 for light duty floor finish.

After the wearing course has hardened sufficiently to prevent dislodgment of aggregate particles, it shall be ground down with an approved type of grinding machine shod with free, rapid cutting carborundum stones. Only a light cut shall be taken with the grinder, and care shall be observed to produce a finish of uniform appearance. The floor shall be kept wet during the grinding process. All material ground off shall be removed with a squeegee and the floor shall be flushed with water.

Air holes, pits and other blemishes shall then be filled with a thin grout composed of neat cement paste. This grout shall be spread over the area and worked into the floor surface with the grinding machine.

After all patch fillers have hardened, the floor surface shall receive a second or final grinding to remove the film. It shall then be thoroughly washed and all surplus material removed.

8—Curing and Protection

All freshly placed concrete shall be protected from the elements and from all defacement due to building operations. The contractor shall provide and use when necessary tarpaulins completely to cover or enclose all freshly finished concrete.

If at any time in the progress of the work the temperature is, or in the opinion of the engineer will, within twenty-four (24) hours, drop to 40 deg. F. the water and aggregate shall be heated and precautions taken to protect the work from freezing for at least five (5) days.

As soon as the concrete has hardened to prevent damage thereby, it shall be covered with at least one (1) inch of wet sand, or other covering satisfactory to the engineer, and shall be kept continually wet by sprinkling with water for at least ten (10) days.

Proposed Recommended Practice for Dusted-on Floor Finish

1—Where Used

Dusted-on floor finish shall be used only where the structural concrete has been produced and placed under absolute control of the water-cement ratio and where the water-cement ratio of the structural concrete does not exceed 7½ gals. of water per bag of cement.

Dusted-on floor finish shall not be permitted on structural concrete where the fine aggregate contains more than 5 per cent passing 100 mesh, or more than 15 per cent passing 50 mesh, nor where the fine aggregate contains dust, clay, loam or vegetable matter. It is assumed, furthermore, that the coarse aggregate in the structural concrete consists of hard, clean, coarse particles, free from dust, clay, loam or vegetable matter, and from coatings which will tend to weaken the topping.

2—Materials

The mixture to be used for spreading on the structural slab shall consist of standard portland cement, and any of the following:

(A) Screened, sharp, clean, coarse particles taken from sand, meeting the above specifications, or

(B) Metallic aggregates approved by the engineer, or

(C) Ground quartz, or other dense rock screenings between the sizes 1/32-in. to ¼-in.

All aggregates shall be selected with care, and approved by the engineer before use. Sample of the proposed material shall be submitted to the engineer for approval before using.

3—Mixture

The mixture to be spread on the screeded off concrete shall be one part of portland cement to one or one and a half parts of fine aggregate, as selected by the engineer.

These materials shall be mixed dry in a mortar box, or in an approved mixing machine.

The material, after mixing, shall be bagged for the purpose of determining the quantity used on the structural slab.

4—Consistency of Structural Slab

The dry-mixed material shall not be placed on the structural slab until it has been allowed to settle after screeding and all surface water has been removed by a darby or other approved means.

5—Placing and Compacting

When the structural slab is in condition so that all surface water has disappeared, or been removed, the dry-mixed material shall be applied at the rate of one bag to each one hundred square feet of floor area.

The dry material after spreading, shall be floated off and worked into the slab. Floating operation shall be stopped as soon as the dry material becomes sloppy and wet, and floating withheld until the surface moisture has disappeared.

6—Finishing by Troweling

After the first floating the floor surface shall stand without working from 20 to 30 minutes, depending on weather conditions. The floor area shall then be compacted with a wood float. The surface shall then be tested with a straightedge to detect high and low spots which shall be eliminated. Floating shall be followed by steel troweling after the concrete has hardened sufficiently to prevent excess fine material from working to the surface. The finish shall be brought to a smooth surface free from defects and blemishes. After the concrete has further hardened additional troweling may be required. This shall be done as may be directed by the engineer.

7—Finishing by Grinding

If a ground surface is desired, the dry material may be merely floated and all inequality evened out by proper floating and only one slight troweling thereafter.

After the surface and the structural slab have hardened sufficiently to prevent dislodgment of aggregate particles, it shall then be ground down with an approved type of grinding machine, shod with free, rapid cutting carborundum stones to expose the coarse aggregate. The floor shall be kept wet during the grinding process. All material ground off shall be removed with a squeegee and the surface flushed with water.

Where required air holes, pits and other blemishes shall then be filled with a thin grout composed of one part of No. 80 grain carborundum grit and one part of portland cement. This grout shall be spread over the surface and worked into the pits with a steel straightedge, after which the grout shall be rubbed into the floor surface with the grinding machine.

After all patch fillers have hardened for seven days the floor surface shall receive a second or final grinding to remove the film and to give the finish a polish. It shall then be thoroughly washed and all surplus material removed.

Materials and Equipment for Bermuda Structure to Be Shipped from New York

Under the terms of a contract just made all equipment and materials, including sand and gravel, to be used in the construction of a reinforced concrete hotel in Bermuda will be assembled in New York City and conveyed to Hamilton, Bermuda, by boat.

Arriving there, shipments will be unloaded at the hotel dock a few hundred feet from the site and transported to the point of use on a miniature railway system installed for the purpose by the contractors. The sand and coral rock of Bermuda are unsuitable for use in reinforced concrete. The isle has no fresh water underground and all water used will be gathered by raincatchers.

The structure will be 6½ stories high, the first unit in a large project. The John W. Ferguson Company of New York is building the structure for the Princess Hotel Co., Ltd., Bermuda.

Personals

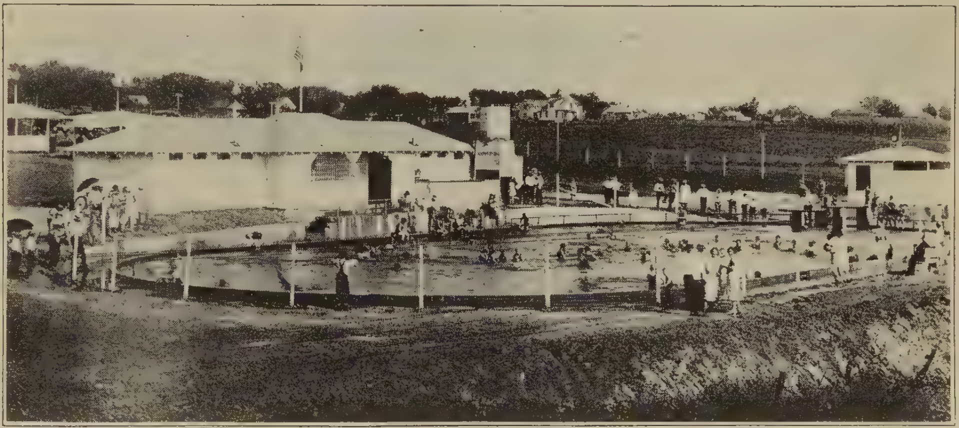
Dr. O. E. Harder has joined the Battelle Memorial Institute, Columbus, Ohio, as assistant director.

After spending two years as food analyst at the University of Kansas, Dr. Harder joined the Chicago office of the Portland Cement Association. He left to make a connection with the N. K. Fairbanks Co., also in Chicago, leaving there to go to the Mellon Institute for research work at Pittsburgh. The following year he joined the staff of the University of Minnesota, where he was engaged as teacher and consultant for the last 11 years in the metalography department.

Construction and Sanitation of Swimming Pools

A Second Article on This Timely Subject—Selection of Type—Auxiliary Structures and Arrangement—Factors and Methods of Sanitation

ONE of the first considerations when planning a pool installation is the type of pool best suited to the local conditions or requirements. If it is to be an inclosed natatorium the rectangular pool with a gradual gradation of depth from the shallow to the deep end, is the one almost universally chosen. This type is the best for all indoor pools. It is suited for use in holding swimming and diving contests and for purposes of instruction.



This pool is located in Iowa

The most popular pools and those to be discussed in this article are the outdoor pools for summer use. Such installations may be municipal pools or they may be privately owned by an individual or organization and operated for profit.

Types of Outdoor Pools

In deciding the best type of outdoor pool to be built different conditions are met with than in the case of the indoor pool. People of both sexes and of all ages will use the outdoor pool and a large number will be non-swimmers. For this reason a large portion of the pool area must vary in depth from about 18 in. to 5 ft. to provide a depth of water in which the average person can either swim or wade.

Another consideration is the safety of patrons, especially children. To meet this requirement a type that is commonly described as the shallow wall, saucer or spoon shaped bottom type of pool is usually selected.

In this type the wall is the same height around the entire pool and the water depth is constant at any point near the wall. About 18 in. is the right depth at the wall. The bottom slopes downward from the side wall toward the center. In very large pools a maximum depth of 8 or 9 ft. is obtained in the center of the pool and it is here that the diving boards, tower, etc., are placed. Steel posts are set in the concrete around the deep portion and a guard rope is used to divide the deep and shallow water.

Diving Provisions

In smaller pools the slope of the bottom would be too steep if the maximum depth at the center is wanted. In such cases one of the semi-circular ends is roped off for diving. The bottom in this portion is pitched at an angle of about 40 degrees to attain the maximum depth about 15 ft. from the wall. The spring boards are supported at the fulcrum point on a concrete pier built on this slope and anchored to concrete steps at the wall line. This carries the board out far enough for diving in the deep water. A pipe rail is set in the wall at this deep end as a safeguard to prevent smaller children from entering at the point where the bottom slope is rapid. A guard rope is stretched across the pool dividing the deep and shallow water.

The hydrostatic head is small at the wall and therefore the wall can be lighter and have less reinforcing than the deep wall type, making it the least expensive pool to build.

Another type of pool that is used in some instances is about the same as the one described above except that the floor is not concreted. The bottom clay is puddled and several inches of sand are placed over the entire area. Where an unlimited supply of water is available this type of pool has its merits, as it is cheaper to build and the sand bottom and beach have attractions. Where recirculation and purification must be resorted to, the puddle bottom pool is not to be advised. There is danger of considerable water loss through seepage and the turbid condition of the water makes it difficult or impossible to sanitize properly.

Whatever the type of pool selected, it should be well designed and constructed with proper attention to the concrete mixture, reinforcing, and adequate expansion joints. It should be built large enough to meet the requirements of the community because it is not practical to enlarge it later. Slighting in the design and the construction of the pool itself is poor economy. If economy is necessary there are other parts of the installation where temporary savings can be made and where these desirable refinements can be added later when more funds are available.

Auxiliary Structures

There is a wide latitude for the expenditure of funds in the construction of the bath house. Its essential features are adequate dressing room facilities for the patrons, a system of checking clothing, showers and toilets, and proper ventilation. If funds are limited, an attractive frame building can be built. Stucco on metal lath will appeal to some and in many cases concrete block or tile make ideal construction materials. A concrete floor with adequate drains should be used in every case.

One of the popular swimming pools at New York City

Some installations have individual steel lockers where patrons may place their clothes while using the pool. This system is ideal but expensive and requires a large building.

A system of checking that meets with popular favor at a great many places is the "basket system." Attractively stained baskets of the market basket variety but without handles, are used. The patron places his clothes in a basket, gives it to an attendant at the check stand and receives a brass tag with a number corresponding to the one on his basket. This system results in economy of space.

The pool should be surrounded with concrete walks so that sand and dirt will not be carried into it on the bathers' feet. A woven wire fence should be built next to the walk and entirely encircling the pool. This fence will keep out dogs and other stray animals and make for cleanliness and orderliness.

Sanitation

The question of sanitation is very important. The system decided upon will depend on three factors—bathing load, quantity of water to be purified, and the funds available. The bathing load is by far the most important of the three and should be the determining factor. A large pool might have but few patrons and therefore need only simple sanitation methods.

A great many indoor pools depend on the refill method every few days, with no chemical treatment whatever. Outdoor pools however, are usually much larger and this system would not be practical. When an unlimited supply of water is available at a low cost, it is often practical to allow it to flow in at one end of the pool and out at the other. This results in a constant change of water and is usually sufficient if the original source is pure water.

By far the greatest number of installations require some means of recirculation, filtration and chemical treatment. The water is usually drawn from the deep part of the pool by means of a centrifugal pump and electric motor, passed through a filter, treated with chlorine and returned to the pool at one or more points. Aerating cascades are sometimes used where the water re-enters the pool.

Filtering Methods

Filters are of two types—the open gravity sand filter and the pressure filter. Here again, the bathing load must be the deciding factor. The open gravity filter is slow in its operation and although efficient if properly designed, a large pool with a big bathing load would require too much filter area to make this type practical.

Efficient pressure filters are available that can be built to filter the entire contents of a pool in almost any time desired. They are usually designed to do this in from 12 to 18 hours. The main purpose of the filter in either case is to remove the suspended impurities from the water and to clarify it. This clarified and filtered water is then treated with chlorine from an automatic chlorination unit which can be set to add any desired amount of chlorine to the water. When the pool and bathing load are large, it is advisable to use pressure filters. Their expense is justified because the absolute assurance of pure water at all times is essential.

For the average small pool in towns and cities of one to four or five thousand people and where the daily bathing load is not large, the open gravity filter, together with chlorination apparatus and circulating pump, will usually be found sufficient. The gravity filter is much cheaper to install and operate and does not have to be housed as do the more expensive pressure filters.

Aggregates Unloaded from Barges for Highway Concrete

A conveying device for unloading sand and gravel from river barges built by the E. T. Slider Company, producers of river sand and gravel at New Albany, Indiana, is shown in the accompanying illustration.

The state of Kentucky has recently awarded a number of contracts for paving with concrete certain sections of what is known as the River Route between Louisville and Cincinnati. The equipment shown in the illustration was built for the express purpose of supplying aggregates for this work, since no stationary unloading plants were available. A conveyor belt carries the material from the barge to the shore.

Sand and gravel for Kentucky highway work being unloaded from river barge

Concrete Products Industry Needs More Substantial Equipment

Too Many Plants Operating With Equipment Bordering on Flimsy—Industry Now Installing Sturdier Machinery—May Require Several Years for Change—High Quality, Clean-Cut Appearance and True Dimensions Among Important Advantages—Capital Required to Stay in Business

The Third and Last of Several Talks With the Products Manufacturer

IT is a difficult matter to discuss the equipment needs and deficiencies of the concrete products industry without appearing to be guilty of trying to boost the business of the equipment manufacturer. In spite of this appearance of guilt, the real purpose of this "talk" is a frank discussion of the question of plant equipment, its bearing on the quality of the product, and the trend toward which the industry is headed.

Whatever may be said here about plant equipment is not to be interpreted as a recommendation that all old equipment be scrapped next week and replaced by new and modern types. It is hoped, however, that the sturdier and more highly automatic machines already installed in some of the larger plants may at least become the goal toward which the managers of plants with old equipment will direct their efforts. Then, when the older pieces have run their course they will not be replaced by similar machines of light and flimsy construction, but by much heavier and more substantial automatic equipment.

There is little question that the products industry is due for a rather thorough overhauling in this matter of equipment, even though several years may elapse before the process is completed. Too many plants are continuing to operate with machinery that borders closely on the flimsy.

Not long ago representatives of "CONCRETE" visited a plant where concrete drain tile were being made. The equipment was so badly centered and so "wobbly" that it was difficult to understand how a good drain tile could be turned out. Somehow this piece of equipment, so old that the manufacturer's name was no longer legible, made a tile of good quality; but it is certain that the product was neither as true to dimensions nor as high in quality as a more sturdy machine could have made.

At a somewhat larger and better equipped plant the operators shoveled the concrete into the molds by hand. Some of the material became packed in the corners of the box-like hopper above the molds. Now and then the operator scraped out the corners with his hands or with a small board, raking the concrete into the mold. That means that an occasional block was made in part of a dried-out mixture of concrete that had but little strength. Some of it may have had its set. While this plant has the reputation of turning out products of high quality, the practice just described must result in a great range of strength between the strongest and the weakest units.

In contrast to the two cases just mentioned, a large plant in Detroit has within the last 18 months replaced every unit of its old equipment with powerful, automatic machines that turn out units of true dimensions and uniform quality. Each machine produces units of standard size at the rate of seven or eight per minute. The human element has been largely eliminated in this plant, for these great machines operate hour after hour with but little attention.

The industry has come a long distance since the day when the concrete block machines exhibited at annual cement shows consisted of light-framed contraptions operated by a foot pedal. The second phase of development was the equipment of which there is still too much in use—equipment having light riveted steel frames, not sufficiently rigid to maintain true alignment under the pounding and vibration of every-day service, and only partly automatic in operation.

Now the industry is installing the heavier and sturdier equipment, fully automatic in its operation. The advantages of this modern machinery are many. It is labor-saving to begin with. It places a plant on a large production basis, for a single machine capable of producing six or eight units of standard size in a minute will have a capacity of 3,600 or 4,800 units in 10 hours of actual operation.

Equipment of this newer type has the further advantage of producing uniform products of high quality; but the greatest advantage of all is its ability to maintain true alignment, which means that the product turned out is clean-cut in appearance and true to dimensions. During these and future years of keen competition with masonry units of other materials, clean-cut appearance and true dimensions will constitute a convincing selling argument. These qualities will in fact be highly essential wherever the advantage of price lies with the other material.

This heavy, automatically operated and large production equipment will of necessity cost more than the older types cost. This is merely another reason why capital is now required to stay in the business of manufacturing concrete products.

Fire Resistive Construction in New York City Building Code

John Lowry, chairman of the building code committee organized by the Merchants' Association, which is now drafting a proposed new building code for the City of New York, has made public the report of the sub-committee on fire resistive construction.

It is contemplated that when the whole new building code is completed, it will make provision for a new type of construction to be known as the partially protected or intermediate type, which, while not as resistive to fire as the present fireproof construction, will eliminate the hazards existing today in non-fireproof six-story apartments. This will be accomplished by using a lighter steel frame, a thin slab, wire lath and plaster partitions and increasing the allowable height of the fire-retardant building above the six stories allowed to non-fireproof structures today, to offset to some extent the increased cost.

All fire resistive construction has been placed on a time and temperature basis. Materials in general use have been assigned ratings based on general experience. The use of other materials is provided for on a test basis and the test procedure is specified.

Suspend New Freight Rates on Cast Stone

The Interstate Commerce Commission has ordered suspension of new freight rates on cast stone until February 1st, 1931. The case has been assigned for hearing at Washington on September 3rd. The Cast Stone Institute, 33 West Grand Avenue, Chicago, advises that where carriers, not knowing of the suspension, attempt to collect the new rates, the former should be notified.

New Hampshire Admits Calcium Chloride Curing

The state of New Hampshire has revised its specification on concrete pavement curing to admit the use of calcium chloride on the surface.

The integral method had been used for several years.

New Books and Pamphlets

Shear Diagrams

Moment and Shear Diagrams for Continuous Beams and Rigid Building Frames. By Norman M. Stineman. Paper cover, 6 by 9 inches, 67 pages. Published by the Portland Cement Association, Chicago, as an authorized reprint from the Journal of the American Concrete Institute, January, 1930.

The moment and shear diagrams in this paper are intended primarily for the design of the structural frames of buildings and for uniform load distribution, or for loading which can be converted into equivalent uniform loads. Values for moments and shears for given loadings may be taken directly from the diagrams.

Pavement Tests

A Study of Tests of Cylinders and Cores Taken From Concrete Roads in Texas During 1928, by John A. Focht. University of Texas Bulletin No. 2922. Published by the University of Texas, Austin, Texas.

This 6 by 9-inch pamphlet contains 18 pages of text and 14 pages of diagrams and tables. Among a number of interesting conclusions is the fact that concrete laid in pavements during the fall and spring months has a higher crushing strength than concrete in pavements laid at other seasons of the year.

Chemistry Handbook

Handbook of Chemistry and Physics. By Charles D. Hodgman and Norbert A. Lange. Flexible binding, 4 by 6½ inches, 1,386 pages. Published by the Chemical Rubber Publishing Company, Cleveland, Ohio. Price $5.00.

This is the fourteenth edition of this useful handbook, which first appeared in 1914, new editions having been published in all but two years since that time. The book is illustrated with numerous tables, and it includes material on all branches of chemistry and physics and closely allied sciences which are likely to find extensive use. To avoid creating a volume of excessive size, and at the same time to allow for natural growth in knowledge of chemistry and physics, it has been found necessary to exclude material which would be of use only in certain highly specialized lines of work.

Highways Handbook

Highways Handbook, 1929 Edition. Edited by Thos. H. MacDonald, chairman of the Highway Education Board. Paper cover, 6 by 9 inches, 97 pages. Published by the Highway Education Board, 1723 N Street, N. W., Washington, D. C. Price 50 cents.

This publication contains carefully prepared tabulated data on such matters as estimated highway expenditures of various political divisions, bond issues and other sources of income, total mileage of all roads, total mileage of surfaced highways, by types, names of principal state highway officials, apportionment of Federal aid to states, and a wide range of related information. A bibliography of highway literature and a list of organizations interested in highway development are included.

On Coarse Aggregates

Effect of Characteristics of Coarse Aggregates on the Quality of Concrete is the title of a 16-page, 8 by 11 in. publication issued by the National Sand & Gravel Association, Munsey Building, Washington, D. C. This is the fifth of a series of bulletins issued for the information of users of sand and gravel. The author is Stanton Walker, Director of the Engineering and Research Division of the Association.

Swimming Pools

Swimming Pools, a 32-page illustrated booklet issued by the Portland Cement Association, Chicago, Illinois, deals with public, commercial, country club, and private pools. Methods of financing are discussed. The factors influencing the selection of site, determination of size and shape, as well as the general arrangement of swimming pool facilities, are treated in detail.

Catalog of German Publications

Technische Bucher is the title of a 224-page catalog of technical publications issued by Julius Springer, Berlin. The catalog contains a book list and an author list, each arranged alphabetically.

Standard Window Frames for Concrete Masonry Units

Dimension Tables for Window Frames and Openings—Window Frame Details—Need for Distribution of Data Among Architects and Builders—Stocking Lintels and Sills

By L. C. HILL

THERE seems to be a lack of co-operation between the manufacturers of concrete masonry units on the one hand, and the architects and millwork people on the other, regarding the development of standard window frames for buildings of this material.

Some architects say that they hesitate to use concrete units on account of their size, which makes it troublesome to work out the window frames and other openings. Few of them are as familiar with concrete units as they should be. As a result they prefer to use brick or hollow tile, the cost being anywhere near equal.

Variations in Standard Units

The more one learns about window frames, the more surprising it is that we do not have more trouble with them. Every mill makes what is known as standard window frames, yet they are all different. A standard brick mold may be anywhere from 1⅜ to a full 2 in. wide, the weight boxes are different, hardly any two sills are the same or have the same pitch, and a mullion may be anything from six to eight inches wide. This all goes to make a confusing piece of work out of a window frame for a concrete masonry wall opening.

Dimension Tables for Window Openings and Frames

The writer has found that the average mason will use a ⅜ in. mortar joint. Consequently the accompanying dimension tables are based on this fact. It works out fairly well with the balance of the scheme. These tables give the number of courses and the dimensions at a glance, and they save a great deal of time in designing or laying out a plan. Besides the ⅜ in. joint, the size of the unit assumed for the tables is the standard 7¾ by 15¾ in. wall face.

The drawing gives the details for a frame that is acknowledged a standard frame at the majority of mills. It will work out fairly close by using a full 2 in. brick mold as shown, and leaving a ⅜ in. joint next to the brick mold which should be caulked with oakum and either beaded or struck with mortar to make a watertight joint.

Unfortunately we have only three sash of the more common widths which can be used with the 8 by 8 by 16 in. unit without getting into fractional blocks. Few plants go to the trouble of making quarter and three-quarter jamb blocks. The accompanying tables give the different size sash that can be used in the two-block, two-and-a-half block singles and the four-and-a-half block mullion. These tables give the glass size, sash opening, over-all frame opening and the length of the lintels and sills corresponding. The cross-section of the lintels and sills are to be as shown in the detail.

Half of the sash sizes come out evenly with a full block in height. With the other sizes it is necessary to work in a 4 in. course under the stone sill, the 4 in. unit having an actual height of 3¾ in.

For those who are not so familiar with sash and frames, it may be stated that by adding 4 in. for the two stiles to the glass width gives you the sash opening. Likewise, adding 4 in. for the two brick molds gives the over-all frame opening width.

Sash Sizes for Mullions

Single Double-Hung Check Rail

Two Blocks Wide

Glass Size	Sash Opening	Over-All Frame Opening	Lintel	Sill
In. In.	Ft. In. Ft. In.	Ft. In. Ft. In.	Ft. In.	Ft. In.
24 x 16	2 4 x 3 2	2 8 x 3 7	4 0	2 7⅞
24 x 18	2 4 x 3 6	2 8 x 3 11	4 0	2 7⅞
24 x 20	2 4 x 3 10	2 8 x 4 3	4 0	2 7⅞
24 x 22	2 4 x 4 2	2 8 x 4 7	4 0	2 7⅞
24 x 24	2 4 x 4 6	2 8 x 4 11	4 0	2 7⅞
24 x 26	2 4 x 4 10	2 8 x 5 3	4 0	2 7⅞
24 x 28	2 4 x 5 2	2 8 x 5 7	4 0	2 7⅞
24 x 30	2 4 x 5 6	2 8 x 5 11	4 0	2 7⅞
24 x 32	2 4 x 5 10	2 8 x 6 3	4 0	2 7⅞
24 x 34	2 4 x 6 2	2 8 x 6 7	4 0	2 7⅞
24 x 36	2 4 x 6 6	2 8 x 6 11	4 0	2 7⅞

Single Double-Hung Check Rail

Two-and-a-Half Blocks Wide

Glass Size	Sash Opening	Over-All Frame Opening	Lintel	Sill
In. In.	Ft. In. Ft. In.	Ft. In. Ft. In.	Ft. In.	Ft. In.
32 x 18	3 0 x 3 6	3 4 x 3 11	4 8⅛	3 4
32 x 20	3 0 x 3 10	3 4 x 4 3	4 8⅛	3 4
32 x 24	3 0 x 4 6	3 4 x 4 11	4 8⅛	3 4
32 x 26	3 0 x 4 10	3 4 x 5 3	4 8⅛	3 4
32 x 28	3 0 x 5 2	3 4 x 5 7	4 8⅛	3 4
32 x 30	3 0 x 5 6	3 4 x 5 11	4 3⅛	3 4
32 x 32	3 0 x 5 10	3 4 x 6 3	4 8⅛	3 4
32 x 34	3 0 x 6 2	3 4 x 6 7	4 8⅛	3 4
32 x 36	3 0 x 6 6	3 4 x 6 11	4 3⅛	3 4

Mullion

Four-and-a-Half Blocks Wide

Glass Size	Sash Opening	Over-All Frame Opening	Lintel	Sill
In. In.	Ft. In. Ft. In.	Ft. In. Ft. In.	Ft. In.	Ft. In.
27 x 20	2 7 x 3 10	6 ½ x 4 3	7 4⅜	6 ½
27 x 22	2 7 x 4 2	6 ½ x 4 7	7 4⅜	6 ½
27 x 24	2 7 x 4 6	6 ½ x 4 11	7 4⅜	6 ½
27 x 26	2 7 x 4 10	6 ½ x 5 3	7 4⅜	6 ½
27 x 28	2 7 x 5 2	6 ½ x 5 7	7 4⅜	6 ½
27 x 30	2 7 x 5 6	6 ½ x 5 11	7 4⅜	6 ½
27 x 32	2 7 x 5 10	6 ½ x 6 3	7 4⅜	6 ½

Calculating Length of Sash

For calculating the length of double hung sash, to the sum of the two glass lengths, add 2 in. for the top rail, 1 in. for the meeting rail and 3 in. for the bottom rail. To arrive at the over-all frame opening length, add to the above sash opening 2 in. for the head mold and 3 in. for the wood sill, as shown in the detail. To get the over-all frame and stone sill dimension, add 6¼ in. for the stone sill.

In order to leave the joint between the brick mold and the jamb block for caulking, a lath is usually stood on end and the block laid against it, the lath later being taken out and the joint caulked, as mentioned before.

Even on a plain block-stuccoed job, it saves a great deal of the masons' time if the frames work out right without requiring the breaking of concrete units or using brick around the openings. It certainly does not look well to have to resort to such "jack-leg" methods.

Stocking Precast Lintels and Sills

Another point the writer would like to emphasize is the stocking of precast lintels and sills. Many still insist that it cannot be done. If you educate the trade to using standard frames there is no reason why you cannot stock a sufficient amount to keep ahead of the demand. Not all manufacturers of concrete masonry units are familiar with the design of concrete structures. There seems to be a little confusion regarding the amount of reinforcing in precast lintels for these common size openings. Consequently the following information may be of assistance:

A reinforced 7¾ by 8 in. lintel as detailed has only a sufficient amount of concrete in compression to develop 0.38 sq. in. of steel in tension. Therefore nothing is gained by using more than two ½ in. round bars as reinforce-

Dimension Tables

Vertical Block Courses

Based on Concrete Units 8x7¾x15¾ in.

Mortar Joints ⅜ in.

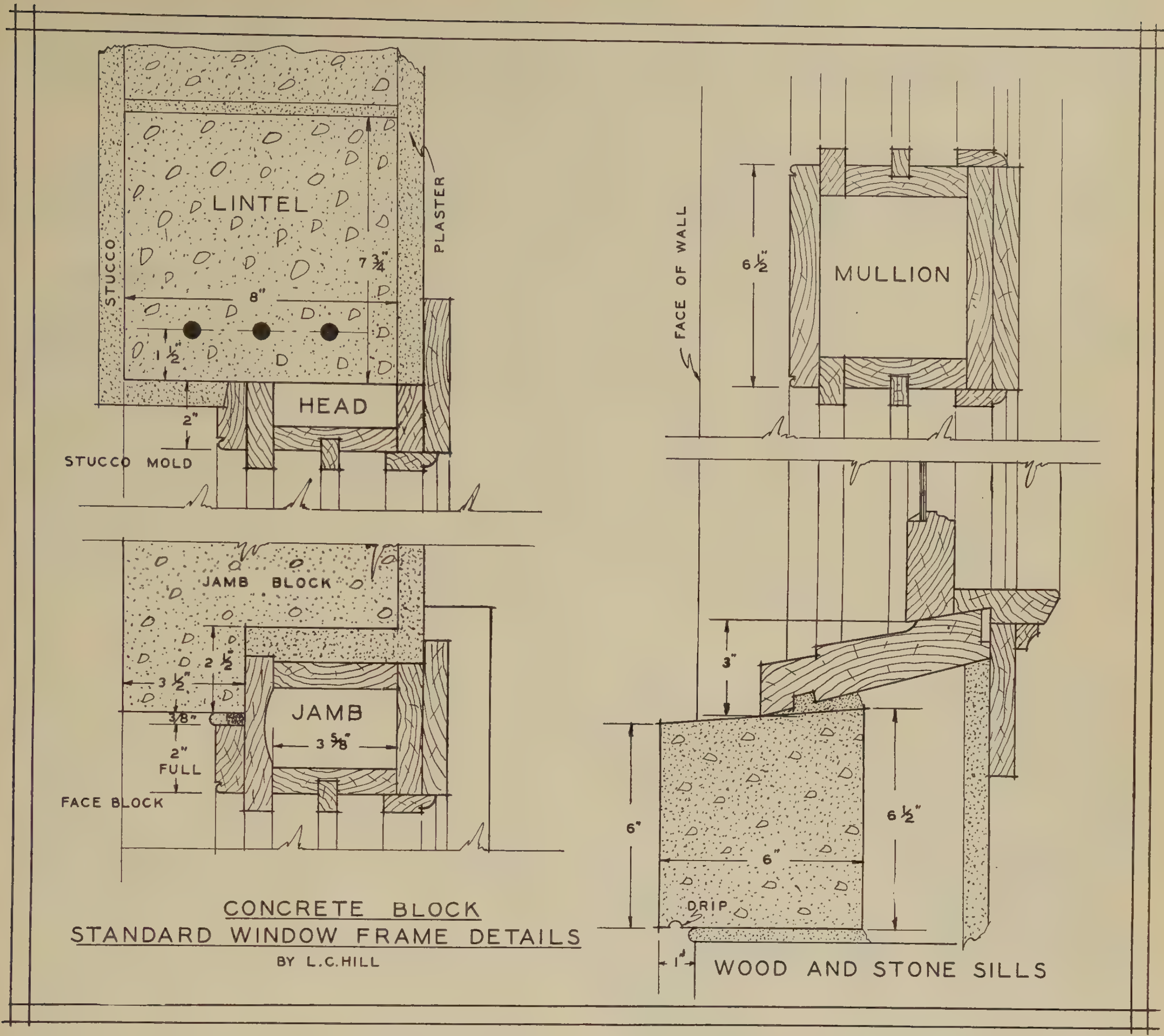
No. Courses	Blocks and Joints In.	Height Ft.	Height In.
	⅜		⅜
1	7¾		8⅛
	⅜		8½
2	7¾	1	4¼
	⅜	1	4⅝
3	7¾	2	0⅜
	⅜	2	0¾
4	7¾	2	8½
	⅜	2	8⅞
5	7¾	3	4⅝
	⅜	3	5
6	7¾	4	0¾
	⅜	4	1⅛
7	7¾	4	8⅞
	⅜	4	9¼
8	7¾	5	5
	⅜	5	5⅜
9	7¾	6	1⅛
	⅜	6	1½
10	7¾	6	9¼
	⅜	6	9⅝
11	7¾	7	5⅜
	⅜	7	5¾
12	7¾	8	1½
	⅜	8	1⅞
13	7¾	8	9⅝
	⅜	8	10
14	7¾	9	5¾
	⅜	9	6⅛
15	7¾	10	1⅞
	⅜	10	2¼
16	7¾	10	10
	⅜	10	10⅜
17	7¾	11	6⅛
	⅜	11	6½
18	7¾	12	2¼
	⅜	12	2⅝
19	7¾	12	10⅜
	⅜	12	10¾
20	7¾	13	6½
	⅜	13	6⅞
21	7¾	14	2⅝
	⅜	14	3
22	7¾	14	10¾
	⅜	14	11⅛
23	7¾	15	6⅞
	⅜	15	7¼
24	7¾	16	3
	⅜	16	3⅜
25	7¾	16	11⅛
	⅜	16	11½
26	7¾	17	7¼
	⅜	17	7⅝
27	7¾	18	3⅜
	⅜	18	3¾
28	7¾	18	11½
	⅜	18	11⅞
29	7¾	19	7⅝
	⅜	19	8
30	7¾	20	3¾
	⅜	20	4⅛
31	7¾	20	11⅞
	⅜	21	0¼
32	7¾	21	8
	⅜	21	8⅜
33	7¾	22	4⅛
	⅜	22	4½
34	7¾	23	0¼
	⅜	23	0⅝
35	7¾	23	8⅜
	⅜	23	8¾
36	7¾	24	4½
	⅜	24	4⅞
37	7¾	25	0⅝
	⅜	25	1
38	7¾	25	8¾
	⅜	25	9⅛
39	7¾	26	4⅞
	⅜	26	5¼
40	7¾	27	1

Horizontal Block Courses

Horizontal Joints

Based on ⅜ in. Joints

No. Courses	Blocks and Joints In.	Length Ft.	Length In.
	⅜		⅜
1	15¾	1	4⅛
	⅜	1	4½
2	15¾	2	8¼
	⅜	2	8⅝
3	15¾	4	0⅜
	⅜	4	0¾
4	15¾	5	4½
	⅜	5	4⅞
5	15¾	6	8⅝
	⅜	6	9
6	15¾	8	0¾
	⅜	8	1⅛
7	15¾	9	4⅞
	⅜	9	5¼
8	15¾	10	9
	⅜	10	9⅜
9	15¾	12	1⅛
	⅜	12	1½
10	15¾	13	5¼
	⅜	13	5⅝
11	15¾	14	9⅜
	⅜	14	9¾
12	15¾	16	1½
	⅜	16	1⅞
13	15¾	17	5⅝
	⅜	17	6
14	15¾	18	9¾
	⅜	18	10⅛
15	15¾	20	1⅞
	⅜	20	2¼
16	15¾	21	6
	⅜	21	6⅜
17	15¾	22	10⅛
	⅜	22	10½
18	15¾	24	2¼
	⅜	24	2⅝
19	15¾	25	6⅜
	⅜	25	6¾
20	15¾	26	10½
	⅜	26	10⅞
21	15¾	28	2⅝
	⅜	28	3
22	15¾	29	6¾
	⅜	29	7⅛
23	15¾	30	10⅞
	⅜	30	11¼
24	15¾	32	3
	⅜	32	3⅜
25	15¾	33	7⅛
	⅜	33	7½
26	15¾	34	11¼
	⅜	34	11⅝
27	15¾	36	3⅜
	⅜	36	3¾
28	15¾	37	7½
	⅜	37	7⅞
29	15¾	38	11⅝
	⅜	39	0
30	15¾	40	3¾
	⅜	40	4⅛
31	15¾	41	7⅞
	⅜	41	8¼
32	15¾	43	0
	⅜	43	0⅜
33	15¾	44	4⅛
	⅜	44	4½
34	15¾	45	8¼
	⅜	45	8⅝
35	15¾	47	0⅜
	⅜	47	0¾
36	15¾	48	4½
	⅜	48	4⅞
37	15¾	49	8⅝
	⅜	49	9
38	15¾	51	0¾
	⅜	51	1⅛
39	15¾	52	4⅞
	⅜	52	5¼
40	15¾	53	9
	⅜	53	9⅜
41	15¾	55	1⅛
	⅜	55	1½
42	15¾	56	5¼
	⅜	56	5⅝
43	15¾	57	9⅜
	⅜	57	9¾
44	15¾	59	1½
	⅜	59	1⅞
45	15¾	60	5⅝
	⅜	60	6
46	15¾	61	9¾
	⅜	61	10⅛
47	15¾	63	1⅞
	⅜	63	2¼
48	15¾	64	6
	⅜	64	6⅜
49	15¾	65	10⅛
	⅜	65	10½
50	15¾	67	2¼
	⅜	67	2⅝
51	15¾	68	6⅜
	⅜	68	6¾
52	15¾	69	10½
	⅜	69	10⅞
53	15¾	71	2⅝
	⅜	71	3
54	15¾	72	6¾
	⅜	72	7⅛
55	15¾	73	10⅞
	⅜	73	11¼
56	15¾	75	3



CONCRETE BLOCK
STANDARD WINDOW FRAME DETAILS
BY L.C.HILL

ment. These should be placed as shown in the lintel detail, the center of gravity of the bar being 1½ in. up from the bottom of the lintel. The safe uniform load on this lintel over a 6 ft. clear span is 440 lbs. per lin. ft. in addition to its own weight.

In wider openings, as for triples for instance, where the clear span is usually around 8 ft. an 8 by 11¾ in. lintel should be used. The concrete in compression in this lintel will develop 0.62 sq. in. of steel in tension, or two ⅝ in. round bars. The safe uniform load on this lintel over an 8 ft. clear span is 700 lbs. per lin. ft., in addition to its own weight.

Where two bars are used in any lintel, one should be bent up and the other should be straight, and both should be hooked at the ends. In using this 8 by 11¾ in. lintel a 4 in. course of block is laid directly on top of the lintel to fill out the two courses.

Most manufacturers of precast lintels place the same amount of steel in both top and bottom of the lintels, or else mark the top plainly. These precautions seem necessary, for some masons are very careless and are apt to set the lintel upside down, thus losing the effect of the reinforcing altogether.

Highway Engineers Publish Regimental Paper

The Twenty-third Engineers, highway and bridge construction regiment which was recruited by extensive trade journal advertising in 1917, has commenced publication of a newspaper for its members.

As the men came from every state in the union there is slight chance of their being together again, but it is believed that this periodical will aid in renewing friendships formed during the World War.

The new paper is named The Highwayman, as was the one published overseas by the regiment.

British Government Laboratory for Highway Research

To foster active experiment and stimulate development, the Ministry of Transport of the British Government has recently equipped an experimental station at Harmondsworth, where laboratory research and full-scale experiments will be carried on enabling scientific investigation to be made into the engineering problems of concrete highway and bridge construction.

INFORMATION *and* CONSULTATION

THE HOW-TO-DO-IT DEPARTMENT

These columns are devoted to helping readers solve their problems in all phases of concrete work. Inquiries are invited. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Sizes and Weights of Reinforcing Bars

With reference to your editorial entitled "Odd Sizes of Bars Cost Money," printed in the June issue of CONCRETE, *will you please state the sizes and weights of the eleven standard sizes mentioned?—F. R. F., Van Wert, Ohio.*

The following tabulation gives the eleven standard sizes which have been in effect since 1925 in conformity with the United States Department of Commerce Simplified Practice Recommendation No. 26. The weights in this tabulation are the billing weights adopted on April 1st, 1930, at the sixth annual meeting of the Concrete Reinforcing Steel Institute.

Size	Area in Sq. in.	Weight in Lbs. Per Lin. Ft.
¼ in. round	.049	.17
⅜ in. round	.110	.38
½ in. round	.196	.68
½ in. square	.250	.86
⅝ in. round	.307	1.06
¾ in. round	.442	1.52
⅞ in. round	.601	2.07
1 in. round	.785	2.70
1 in. square	1.000	3.44
1⅛ in. square	1.266	4.35
1¼ in. square	1.563	5.37

Laitance, Slump, Humus and Clay, Curing

Will you kindly give me information on the following points?

(1) *What is laitance?*

(2) *Explain what slump means and how it is used.*

(3) *What per cent of humus or clay may a mixture of concrete contain?*

(4) *What is the purpose of keeping concrete moist during the curing period?—W. McC., Toronto, Ontario.*

The following answers are numbered to correspond with the numbers before your questions:

(1) Laitance is the name given to the fine scum which comes to the surface of freshly placed concrete when the mixture contains an excessive amount of water. The scum particles consist mostly of cement held in suspension by the excess water. These particles of cement have no further cementing value, and when the scum, or laitance, has dried out it has very little strength and very little weather resistive value. It is simply a soft, chalky layer between harder layers of concrete and provides a seam for disintegration to begin. The formation of laitance can be prevented by using the proper amount of mixing water.

(2) The slump of concrete is the amount by which the upper surface of a truncated cone of freshly mixed material sinks when the cone is lifted. The slump is not a direct indicator of strength, but is primarily a measure of the consistency of fresh concrete. The standard cone for the slump test is 12 in. high, 8 in. in diameter at the base and 4 in. in diameter at the top. The slump is usually expressed in inches.

(3) Concrete should not be allowed to contain humus, which comes from decayed vegetable matter and is likely to be harmful even in small quantities. It is most likely to be present in unwashed sand. In regard to clay, a pure clay is not harmful, and in fact it may be beneficial, in quantities up to 10 per cent of the weight of the sand. It is seldom, however, that pure clay is present in sand. Usually there are various impurities mixed in with the clay, so that it is not considered safe to have more than 3 to 5 per cent of the weight of the sand. Actual tests will answer the question in individual cases.

(4) Moisture during the curing period is necessary because water must be present to continue the chemical action with the cement. It is this chemical action, or hydration, that causes the hardening of concrete. If the mixing water is allowed to dry out prematurely this hydration stops, and the concrete can not attain its full strength.

Highway Sidewalk Law

We are interested here in a proposed state law authorizing highway departments to build sidewalks along state roads. We understand such a law has been passed by an eastern state. Can you supply us with the details?—E. C. B., South Bend, Ind.

You are probably referring to the New Jersey law approved on April 8th, 1930, and known as Act No. 74, New Jersey Laws of 1930. The Act is quoted in full, as follows:

BE IT ENACTED by the Senate and General Assembly of the State of New Jersey:

> 1. In addition to the powers conferred upon the State Highway Commission it shall be lawful, and the commission is hereby authorized and empowered, to construct paths or sidewalks and curbing along State highways and other roads and highways, subject to the jurisdiction of the commission, from any moneys available to said commission; and further is empowered in connection with such construction, as aforesaid, to enter into agreements with counties and other municipalities to share the cost of such construction, and thereafter of the maintenance and reconstruction of such paths, sidewalks and curbing so constructed.
>
> 2. This act shall take effect immediately.

Concrete for the Builder

A Department Devoted to the Promotion and Practical Construction Details of Concrete Work

Building Concrete Tanks for Cooling Milk

Builders Can Get Considerable Business in Sections Where Milk Ordinances Are Being Rigidly Enforced—Many Dairy Farmers Must Have Concrete Milk Houses—Insulated Tanks in Demand

AT present there is a nationwide movement, sponsored by the United States Public Health Service and being carried on by state, county and city health officials, for improving the quality of milk. And this movement, as some contractors are aware, is opening up a good market for concrete work, especially in sections where milk ordinances are being enforced for the first time. Many ordinances require that floors in dairy barns and milk houses be of concrete construction to provide clean quarters for the cows and sanitary facilities for handling milk. In fact, it is not readily possible to meet the sanitary requirements of most milk laws except through the use of concrete which is impervious and easy to keep clean.

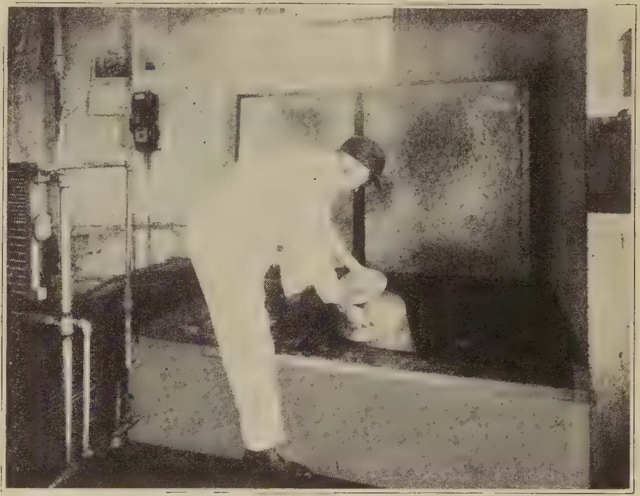
How to Build Tanks

Although this movement for more sanitary dairy barns and milk cooling equipment opens up a market for several kinds of concrete work, including floors, mangers, curbs, feed alleys, litter alleys in barns and concrete floors and walls in milk houses, this article is intended to give contractors information on the most recent methods for building concrete tanks of the insulated type.

The insulated tank is in great demand today because it is recommended for use when either ice or mechanical refrigeration is used for cooling the milk. This type insures more efficient use of ice or electricity, can be built inside of the milk house, reduces labor in lifting cans because it is built partly below the floor level, prevents galvanic action between the tank and cooling coil, will not freeze, rot or rust, and is economical both in first cost and operation. These are some of the facts concrete contractors can use as sales points in getting concrete tank business from dairy farmers.

Correct Size of Tank

The size of tank to build usually will be determined by the dairy farmer, depending upon the number of cans it must hold at one time plus the necessary amount of cooling water. Table 1 shows inside dimensions for tanks of various sizes. These tanks will have the proper ratio of water to milk for efficient cooling. Space is also provided for ice or the cooling coils of most types of



This insulated concrete tank is equipped for mechanical refrigeration

TABLE 1

Inside Dimensions of Insulated Milk Cooling Tank for Ice or Mechanical Refrigeration

Capacity of Tank						
Total Storage Capacity 40 Qt. Cans	Cans Cooled per Milking—One Cooling Daily 40 Qt. Cans	Cans Cooled per Milking—Two Coolings Daily 40 Qt. Cans	Capacity Gallons	Inside Length Feet	Inside Width Inches	Inside Depth Including Plate Inches
4	4	2	160	4	36	28
6	6	3	240	6	36	28
8	8	4	320	8	36	28
10	10	5	400	10	36	28
12	12	6	480	12	36	28

Notes for Table 1:—Where night's milk is allowed to remain in the tank while morning's milk is cooled, a tank large enough to hold the cans from two milkings is needed. Where only the night's milk is cooled or where the cooled night's milk is taken out to make room for the morning's milk, the tank need be only large enough to hold the cans from one milking.

mechanical refrigerating units. Thus a tank in which ice is used for cooling can later be equipped with mechanical refrigeration in case the owner desires to make this change. When mechanical refrigeration is to be used, however, manufacturers' instructions as to the proper size tank to build should be followed, as some units now on the market can not be installed in a tank 3 feet wide.

Best Location for the Tank

Most dairymen prefer to have the cooling tank located against the wall of the milk house, extending it partly or entirely across the building. The inside width of the milk house must therefore be not less than the over-all length of the tank. For example, a tank holding eight cans will be 8 feet long inside. To this is added 1 foot 8 inches, the combined thickness of the two end walls, making the total length 9 feet 8 inches. A milk house to accommodate this tank must be not less than 9 feet 8 inches wide inside the foundation walls. In determining the size of the milk house, be sure to allow space for the cooling unit, pre-cooler and other equipment which is to be installed.

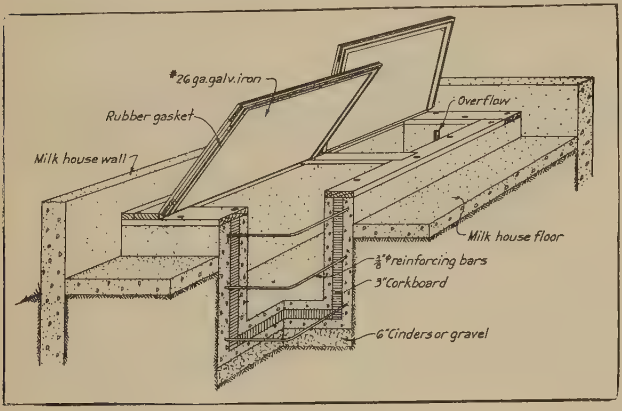


Fig. 1. Perspective view of insulated concrete milk cooling tank; corner cut out to show construction. Note that reinforcement is placed only in outer concrete wall

If the milk house is not supported on a concrete foundation, the first step is to construct such a wall, 8 inches thick, extended down to solid footing and carried at least 30 inches above grade. An opening about 12 inches square is provided in the wall to permit drains from the tank and the milk house floor to pass through as shown in Fig. 2.

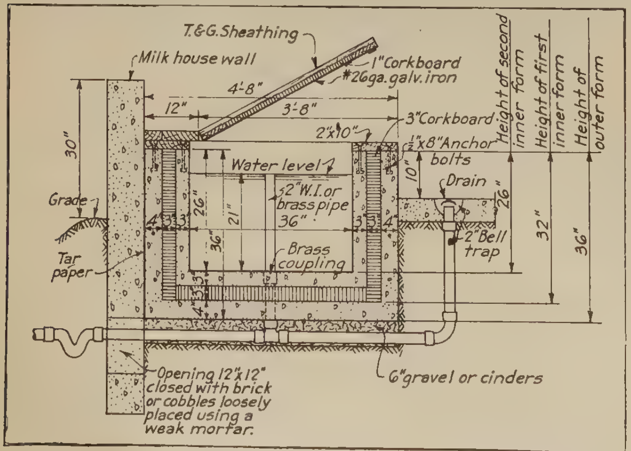


Fig. 2. Cross section of insulated concrete milk cooling tank

Excavating for Tank

Experience has shown that the labor of lifting cans in and out of the tank is considerably lightened when the tank is placed partly below the floor level; 12 inches from the floor surface to the top of the plate or rim around the tank is the most convenient height. The excavation should be slightly larger than the over-all dimensions of the tank to provide room for erecting forms for the outer wall. The hole is dug to a depth 2 feet 8 inches below the level of the finished floor in the milk house. This depth allows for a 6 inch fill of cinders or gravel.

Installation of Overflow and Drains

When the excavation is completed assemble the fittings for the overflow and drains as shown in Fig. 2. These are set so that the top of the coupling in which the overflow pipe is screwed will be flush with the finished floor in the tank. The best location for the overflow pipe is in the middle of one end and about 5 inches in from the inside wall (15 inches in from the outside wall). The overflow pipe and coupling may be of brass or wrought iron and the trap of cast iron or vitrified clay tile.

Constructing Base Slab of Concrete

Where drainage is poor or the ground is subject to heaving, a fill of cinders, gravel or coarse sand 6 inches deep is recommended. Drain tile are placed in the bottom of the fill to insure good drainage. This fill is tamped to provide an even, firm base for the tank.

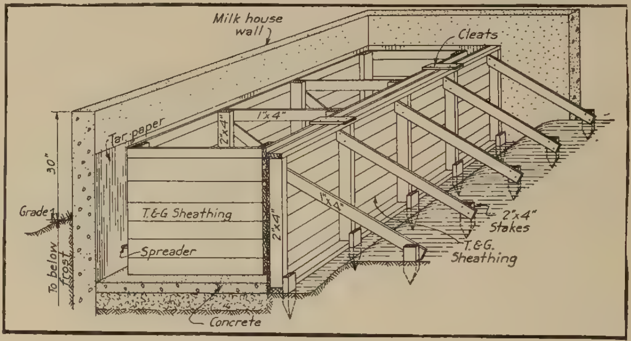


Fig. 3. View showing forms for building outer wall of concrete milk cooling tank

The concrete base slab is made 4 inches thick and of the same size as the outside dimensions of the tank. Edges of the base slab are formed by the outer form work for the tank. (See Fig. 3.) The concrete mixture should be fairly stiff, and should be carefully tamped and leveled off to provide an even surface on which to lay the corkboard. (For information on making concrete see section "Concrete for Outer Wall.")

Forms for Outside Walls

Forms are of 1-inch dressed and matched material stiffened with 2 by 4 inch studs, as shown in Figs. 3 and 4. These drawings also illustrate the manner of bracing forms to hold them rigidly in position. Faces of inner and outer forms must be held exactly 4 inches apart. This can be done by placing spacers—wood blocks 4 inches long—between form faces. These are removed as the forms are filled with concrete. Where the tank extends entirely across the end of the milk house an outer form is required along one side only since the foundation wall serves as a form on the other side and on the ends. A strip of tar paper should be placed against the foundation wall to separate the tank and wall. Then any settlement of the wall will not damage the tank. Form faces coming in contact with the concrete mixture should be oiled. Nails are driven with their heads projecting about 1/4 inch for easy removal. The inner form is cut down later for building the inner wall and should therefore be handled in such a way that it will not become damaged.

Concrete for Outer Wall of Tank

Because the concrete in an insulated milk cooling tank must be absolutely watertight a rich mixture is specified. The correct mixture is one containing 3¾ gallons of water per sack of cement to which such amounts of moist sand and pebbles are added as will produce a plastic, workable concrete. The amount of water to add is decreased to 3½ gallons if sand and pebbles are wet and increased to 4½ gallons if these are thoroughly dry.

As a trial batch combine 1 sack of cement, 2 cubic feet of sand and 2 cubic feet of pebbles (1:2:2 mix) and the amount of water specified (not over 4½ gallons). Use pebbles up to ¾-inch in size. It may be necessary to change the proportions and amounts of sand and pebbles slightly to obtain a smooth, plastic, workable mixture that will place well. For example, suppose the trial proportions give a mixture that is too wet, add more sand and pebbles in equal amounts until the right degree of stiffness is obtained. On the other hand, if the mixture is too stiff use less sand and pebbles. In this way the exact proportions for the job can be obtained. All materials including water should be accurately measured for every batch.

TABLE 2

Quantities of Materials for Insulated Concrete Tanks

(All tanks 36 inches wide, 28 inches deep, inside dimensions)

Materials	Unit of Measurement	Length of Tank 4 Feet	6 Feet	8 Feet	10 Feet	12 Feet
3-inch Cork Board	Sq. Ft.	66	84	102	120	138
Asphalt	Lb.	80	100	120	145	165
Roofing Felt or Cotton Fabric	Sq. Yd.	9	11	13	15	18
Reinforcing rods ⅜-inch	Ft.	66	81	93	105	120
Cement	Sacks	12	15	18	22	25
Sand	Cu. Ft.	24	30	36	44	50
Pebbles	Cu. Ft.	24	30	36	44	50

Note:—Other materials needed include lumber for forms, lumber for cover, insulating lumber for cover, tar paper, hinges, handles, nails. All estimates based on tanks 36 inches wide on the inside. Asphalt weighs approximately 8.3 lb. per gallon. A ⅜-inch reinforcing rod, 10 feet long, weighs about 3¾ lb.

Pebbles, crushed stone or other coarse aggregates should be tough, fairly hard and free from any impurities that are objectionable in sand. Coarse aggregate should be well graded, with sizes ranging from ¼-inch up to ¾-inch.

Mixing should continue until stones or pebbles are completely coated with a mortar of cement and sand. Where a machine mixer is used, the mixing should continue for at least 1½ minutes after all the ingredients are in the mixer drum.

Concrete for the base slab is placed to a depth of 4 inches, as shown in Fig. 3. Before the base hardens, concrete for the outside wall of the tank should be placed in layers 4 inches deep, filling evenly all around. As the concrete is placed it is carefully spaded to remove any air entrapped in the mixture and to give the wall a smooth surface.

With 4 inches of concrete in the forms the first reinforcing bar, a ⅜-inch bar, is placed in the center of the wall. It is bent at the corners, as shown in Fig. 1. All splices should be lapped 15 inches. A second bar is placed when the forms are half filled with concrete and a third bar 4 inches from the top.

When the form is completely filled, ½ by 8-inch anchor bolts are set two feet apart in the concrete with the threaded ends projecting about 1¾ inches. The wooden plate or rim for the cover is later attached to these bolts.

In warm weather the forms usually can be removed in 24 hours. More time should be allowed in cool weather. When forms are removed the floor and inside wall are painted with hot asphalt.

Placing Corkboard

Corkboard 3 inches thick is specified for insulating floor and walls. Corkboard comes in pieces 1 foot wide and 3 feet long and may be readily cut with a saw. Since corkboard loses its value as an insulator when wet it must be kept absolutely dry. For this reason it is waterproofed by dipping it in or mopping it with hot asphalt on all surfaces. The edges are again painted with the hot asphalt when the pieces are fitted together. The corkboard is set in place against the wall and cut to correct fit before being waterproofed. Corkboard for floor is likewise cut and fit before being given the asphalt treatment. As a further precaution to keep out moisture the corkboard is covered with a single-ply uncoated roofing paper or a woven cotton fabric made especially for the purpose. This is applied by mopping with hot asphalt to the inner side of the corkboard lining. When applied it is again mopped with hot asphalt. Asphalt having a melting point of 150 to 160 degrees F. is satisfactory.

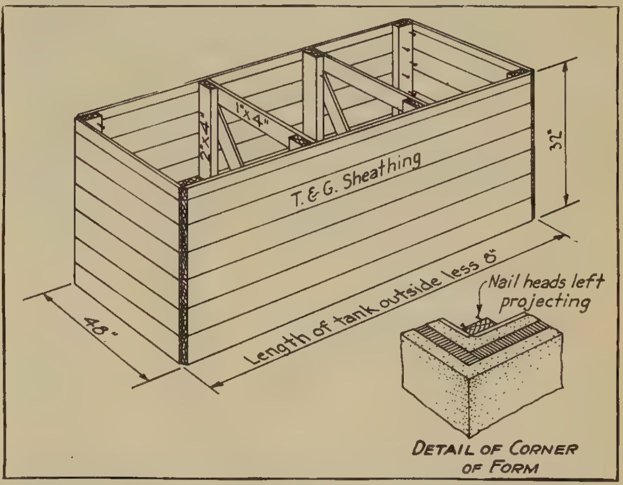


Fig. 4. Inner form for the outer wall of insulated concrete tank. This same form, when cut down, is used for inner form in building inside wall of tank

Building Inner Wall and Floor; Curing

The inner form used in constructing the outside shell of the tank is now cleaned and cut down to the dimensions of the inside of the tank. (See Fig. 4.) This form is then carefully erected with its faces exactly 3 inches from the corkboard and 3 inches above the corkboard floor. Use the same mixture of concrete as in the outer wall. Place floor first, sloping it slightly toward drain. Then construct inside wall, depositing concrete in 4-inch layers, spading carefully to prevent breaking the watertight asphalt seal on the corkboard. No reinforcing steel is placed in the inner wall. When forms are filled, anchor bolts are set in the concrete for attaching the plate. (See Fig. 2.) After the forms are removed, the inside of the tank is painted with a wash of cement and water having about the same consistency as thick cream. The concrete should be cured carefully by covering the tank with burlap and keeping it constantly moist for seven days.

Constructing Rim and Cover

After the concrete has hardened, the plate or rim consisting of 2 by 10 in. planks is attached to the anchor bolts previously set in the wall. A thin bed of cement mortar is used under the plate to secure a tight joint. The nuts on the anchor bolts should be countersunk in the plate to permit a close fitting cover. Bolts with six-sided nuts will be found advantageous.

The cover consists of a 1 by 4 inch frame covered with dressed and matched lumber, filled in with 1 inch insulating lumber with tar paper on both sides, and covered on the bottom side with 26-gauge galvanized sheet metal. Rubber gaskets—old inner tubes or rubber weather stripping—are tacked around the edges of the cover, as indicated in Fig. 1, to seal all joints completely. Hinges should be of galvanized or other rust resisting metal. For a tank 8 feet long or longer, it is advisable to build the cover in two sections for greater ease in opening. In some types of mechanical refrigeration, part of the apparatus is located on top of the tank. Then the cover is so arranged as to open up on either side of this equipment.

Placing Milk House Floor

The final step is the placing of a concrete floor in the milk house. This is made 5 inches thick and sloped toward the drain. Where floor and walls join, the corners are rounded to eliminate angles that hold dirt.

In mixing concrete for floor use 1 part cement, 2 parts sand and 3 parts pebbles as a trial mix. The correct amount of water to add is 4½ gallons per sack of cement when sand and pebbles are moist and 5½ gallons when these are dry. One-course construction is recommended. The concrete should be rather stiff, requiring some tamping to get it to settle into place. A wooden float is used to even up the surface and prepare it for final finishing with the steel trowel. The surface should not be given final finish until the concrete has stiffened slightly. A steel trowel, applied after the concrete has stiffened somewhat, causes fine grains of sand to be pushed down into the concrete, producing a dense surface. The surface of the floor should be kept moist for a week or 10 days.

Tank Without Insulation

The foregoing instructions may be used as a guide in building a tank without insulation in the walls. In this type only one wall, 5 inches thick, is needed. It is reinforced in the same manner as the outer wall of the insulated tank and the other construction details are practically the same. The inside dimensions, however, should be the same as for the insulated tanks. (See Table I.)

Concrete Contractors Can Help Settle Parking Problem; Develop Business for Themselves

Illinois Town Paves Waste Strips of Land Near Business Section—Points Way to Other Towns

Dixon, Ill., is like most other American towns. It has more automobiles than curb space in its business district. Until the city took a hand in the matter, the daily battle for parking space was wasting citizens' time and temper. Merchants complained that traffic congestion was bad for business.

Along the south bank of the Rock River and within two minutes walk of the greater part of the business section there were two undeveloped strips of land—one on either side of the principal bridge.

The idea occurred to the city fathers that these bits of land would make ideal parking space. But, they asked, what is a parking space? Is it merely unoccupied land, paved with mud, dirt and dust? Obviously, motorists would not welcome any such make-shift affair.

So they decided to pave the parking area with concrete. As a result of this decision, Dixon now has paved parking space for two hundred cars or more. It would take more than half a mile of curb to accommodate those cars in the ordinary way.

Dixon, Illinois, knows how to solve the downtown parking problem

What Dixon has done, at relatively small expense, any town can do. Motorists, merchants, shoppers, all benefit. The battle for parking space has been won. And it was one of those battles in which nobody lost.

Concrete contractors can help win similar "battles" in other communities, and develop business for themselves.

Facts and Figures About a Mile of Concrete Pavement

Interesting Facts and Figures Concerning Some of the Markets Available for the Concrete Contractor

It is estimated that a concrete street 8 in. thick and 30 ft. wide will require about 3,910 cu. yds. of concrete and about 5,865 barrels of cement per mile.

Of interest to concrete contractors are the other concrete improvements which can be built at the same time or immediately following construction of the concrete street pavement. In this respect, the following figures tell the story of the possibility of increasing the uses of concrete along this same mile of street:

Type of Construction	Bbl.	Cu. Yd. of Concrete
2—6-in. curbs, 18 in. deep	400	320*
2—5-ft. sidewalks, 5 in. thick	1,220	976*
1—24-in. sewer pipe	460	368
8—street intersections	175	140*
50—house sidewalks	140	112*
50—house driveways	600	480*
1—alley, 6 in. thick and 18 ft. wide	2,190	1,760*

---

*Work the concrete contractor can do.

In addition to the foregoing, catch basins, drains, street marker posts, and electric light poles, would require about 120 cu. yds. of concrete.

The progressive concrete contractor will realize that lawn furniture, garden pools, tennis courts and the many other concrete improvements around the home will be included. Here, right before the concrete contractor, is a tremendous market for concrete improvement.

"Pebble-Studded" Concrete Paving

Paving in War Memorial Plaza, New Britain, Conn., Demonstrates Versatility of Concrete; How Distinctive, Attractive Sidewalks Were Built

The city of New Britain, Connecticut, recently dedicated a magnificent memorial to its World War veterans, the construction of which included an unusual type of concrete sidewalk work. The architect, H. Van Buren Magonigle of New York, wished to make the walks around the memorial and in the plaza unique and different from the ordinary concrete walk. The accompanying photographs illustrate how well this was accomplished. The Hayes Construction Company, of New Britain, built these distinctive, attractive walks.

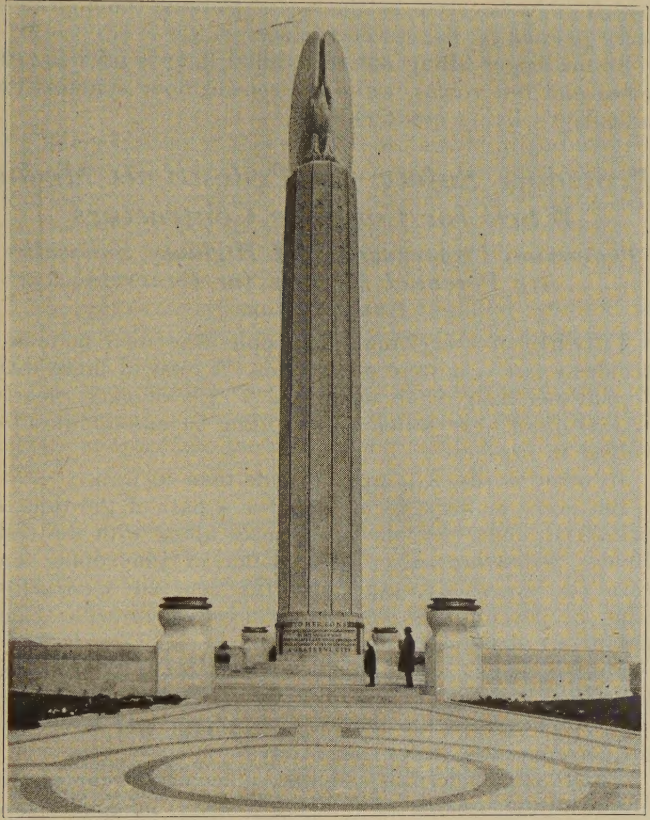


Photo by Richard Averill Smith

The memorial to World War veterans constructed by the City of New Britain, Connecticut. Pebble-studded paving such as appears prominently in the foreground was used in the plaza of the memorial and the approach walks

The construction of the walks was relatively simple. A 5-in. concrete foundation (1:2½:5 mix) was first laid and given a wood float finish. A 1-in. layer of 1:2 portland cement mortar was then spread over the freshly placed concrete before the latter had time to harden. The pebbles were then pressed into the mortar, each pebble being set separately by hand. To secure an even surface across the top of the pebbles and to firmly embed them in the mortar, a board was laid over the pebbles and tamped lightly. To mark out the design and to separate the dark pebbles from the light, thin wooden strips were set in place in the concrete. When the pebbles had been placed and the mortar hardened, these strips were removed and the joints filled with grout.

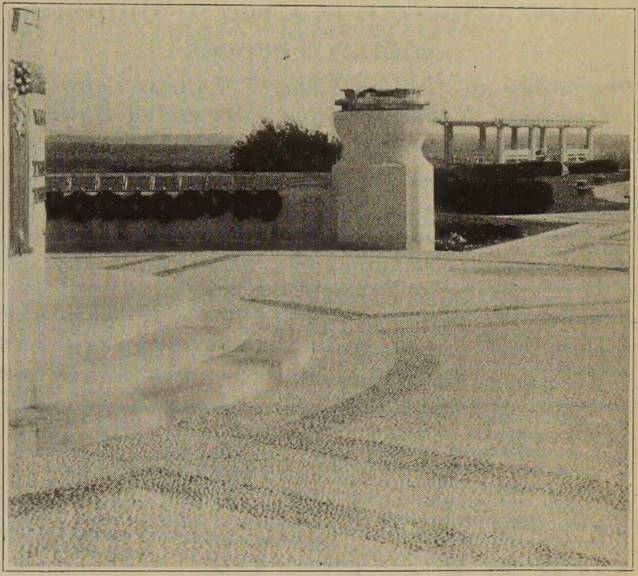
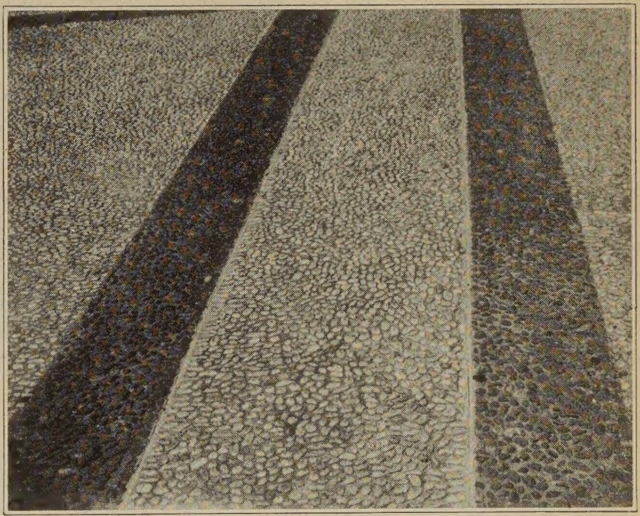


Photo by Richard Averill Smith

The total area of the pebble-studded paving is 9,000 sq. ft. This view shows the plaza at the foot of the monument

Pebbles of uniform size, obtained from a company in New Jersey, were used. They were received in burlap sacks, being separated according to color.



A detail view of the pebble studding. Two shades of colored pebbles were used and all were set separately by hand. Note the uniformity in the size of the pebbles

The area of the plaza is 9,000 sq. ft., and the cost of the "pebble-studded" paving was $1.50 per sq. ft. This high cost is attributed to the fact that the pebbles were all set by hand.

Concrete Ramps at Barns

Many progressive concrete contractors are building concrete ramps, leading up to barn doors, for farmers. Such construction will not rot or go to pieces. It will furnish a solid, non-skid surface in all weather, and it can not burn.

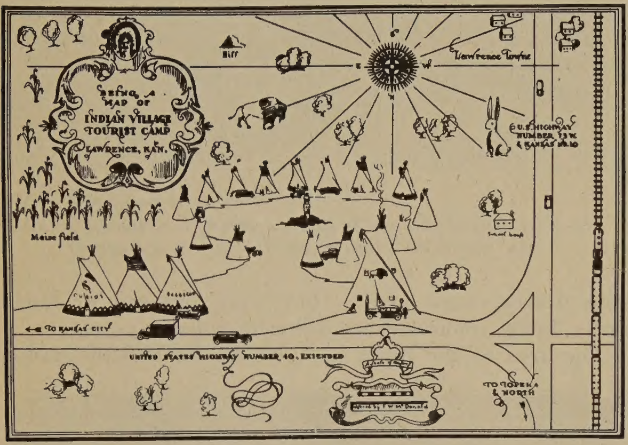
Reinforcing Bars with Excessive Rust

When using reinforcing rods in concrete, be sure to see that the bars are clean and free from scale or excessive rust. These materials prevent a good bond between concrete and the reinforcement.

How Concrete Is Used in Building Indian Teepees

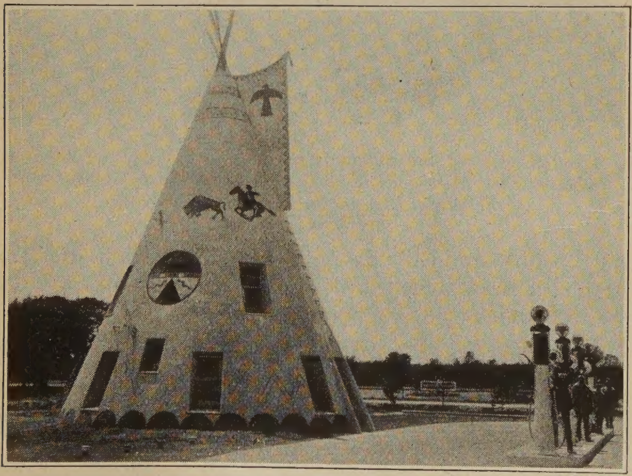
Describing an "Indian Village" Tourist Camp Near Lawrence, Kansas; Teepees Are Being Built of Portland Cement Stucco and Concrete

Perhaps the most unique tourist camp project in the United States today is the "Indian Village" being constructed one mile north of Lawrence, Kansas, on the cut-off between U. S. Highway No. 40 and U. S. No. 73W. Although the use of concrete for building dates back to antiquity, this project probably is the first one in which the material has ever been used for building teepees and pavements in an Indian village.


Being a Map of Indian Village Tourist Camp Lawrence, Kan.
Biff
Lawrence Towne
U. S. Highway Number 73 W & Kansas No. 10
Maize field
School house
To Kansas City
United States Highway Number 40, Extended
To Topeka & North

The artist's conception of the Indian village as it will appear when finished

As shown in the accompanying artist's sketch, this tourist camp is being laid out in the form of an old Indian village, the large filling station representing the chief's teepee which was always the largest and stood in the center of the village. According to present plans, there will be fourteen smaller teepees of similar construction that will be used as tourists' cabins, and three teepees just slightly smaller than the filling station, for commercial purposes.



The first unit or teepee filling station of the Indian village, near Lawrence, Kansas. Footings, foundation and pavement are concrete. The teepee exterior is portland cement stucco applied on metal reinforcement

Portland cement stucco applied on metal reinforcement is being used in building the teepees; pavements, footings, foundations and floors are being built of concrete.

The main teepee, which is used as the filling station, is 32 ft. in diameter at the base and approximately 45 ft. high, supported by concrete footings 27 in. wide by 12 in. thick and a 12 in. concrete foundation wall extending below the frost line.

The first floor is of 4 in. concrete and the concrete driveways are 6 in. thick.

The teepee structure itself is framed with lumber that is covered with metal reinforcement, over which portland cement stucco is applied. The stucco is approximately 1½ in. in thickness. This type of construction also will be used for the other teepees that are included in the plan for the Indian village. The Indian symbols and figures, which may be seen in the accompanying photographs, were painted on the stucco surface.

In the teepee filling station the first floor is used for the office and rest rooms, while the second floor contains the attendant's living quarters.

Providing Safety for Pedestrians Means Work for Concrete Contractors

Pedestrian Underpasses and Highway Sidewalks Are Potential Markets for Concrete Construction

Fifty-five of every hundred people who died in motor accidents last year were pedestrians. A total of more than 18,000 met their death under the wheels of cars; nearly 15,000 more were killed while riding in automobiles involved in crashes.

In other words, it is safer to ride than to walk.

But every motorist is, at least for a part of the time, a pedestrian and must take his chances along with the rest. Hence, pedestrian safety is a matter of immediate concern for everybody, especially the concrete contractor, who can develop new business in cities where safety campaigns are under way.

Most accidents involving pedestrians occur at street intersections. Obviously, the ordinary traffic lights and other control devices, while they are important and necessary, do not guarantee pedestrian safety.

Pedestrian underpasses built of concrete completely eliminate the hazards of crossing a street, no matter how heavy the traffic may be. Grade separations for the intersecting streets help greatly in eliminating confusion—and confusion is probably the element which is most dangerous to the foot traveler.

The greater use of underpasses and grade separation—both of which are primarily concrete structures—is certain to have a distinct effect on the motor accident situation. And motor accidents, according to a report of the National Conference on Street and Highway Safety, are exacting an annual economic loss estimated at more than $850,000,000.

The highway sidewalk is another factor in highway safety. The ordinarily busy, two-lane highway offers little safety to pedestrians, particularly school children. To be entirely safe from passing cars, the walkers must get off the pavement. In many cases, ditches, mud, dust or heavy growths of grass and weeds make it inconvenient or impossible to get off of the pavement. Hence, the pedestrian takes a chance.

Concrete highway sidewalks cost relatively little, but they give the pedestrian a degree of safety not to be had by any other means.

Motorists are realizing that as long as the rate of pedestrian accidents rises faster than the rate of motor car increase, there will be more laws tending to restrict motoring. In this, as in every case, an ounce of concrete prevention is worth a ton of hypothetical cure. Progressive concrete contractors are going after this business.

The Concrete Industry —25 YEARS AGO

LOUIS CHEVALIER, in a 3-page article entitled "Reinforced Concrete Arches," in the August, 1905, issue of CONCRETE, deals largely with the design and reinforcing of arch bridge construction.

* * *

A NEWS report slightly less than a page in length tells of the 3-day eighth annual meeting of the American Society for Testing Materials, then also held at Atlantic City.

* * *

THE editorial of that date, "The Cement Manufacturers' Attitude," takes issue with certain of the latter who had presumably sought, on the plea of lack of knowledge of cement on the part of prospective manufacturers of concrete in various forms to discourage the latter from entering the business.

The editor retaliates with, "The so-called ignorant inquirer of today may become the successful concrete contractor of tomorrow.

"In two notable cases parties who had absolutely no knowledge of portland cement have since established businesses and become purchasers of cement in 10,000 barrel lots."

* * *

THE Concrete Block Machine Manufacturers' Association of quarter century ago was not without prestige and importance. In the words of the writer of that day, "this industry has grown to such proportions and taken such a position in the industrial world as to warrant greater space."

The by-laws are printed, followed by papers presented by J. F. Angel, O. U. Miracle, C. C. Huston, S. L. Wiltse.

* * *

DIMENSIONS and some of the construction details of the much heralded Tacoma Smelter Company chimney at Tacoma, Washington, are contained in a brief article appearing in the August issue of *Cement Age*.

The following is abstracted as being of interest:

"From the base of the foundation to the top of the chimney the distance is 307 ft. 6 in., and the cost of construction will be approximately $28,000.

"The chimney was constructed in two parts. From the foundation up to a height of 90 ft. there are two distinct chimneys, one built around the other; the remainder of the chimney is a solid piece of masonry. The purpose of the double shell is to protect the chimney from the elements.

"The reinforcement of the foundation consists of two networks of 1¼ by 1¼ by 3/16 in. T iron. The bars for the lower network run parallel to the sides and the bars in the second net are placed diagonally. The vertical T bars form a reinforcement for the chimney itself. They vary in length from 16 to 30 feet and are of 1¼ by 1¼ by 3/16 in. material. The vertical bars are encircled by rings of T steel 1 by 1 by ⅛ in., placed 3 ft. apart in the outer shell and single part, and 18 in. apart in the inner shell.

"The chimney was built in 3-ft. sections, and an average of 3 ft. a day was made in the construction of the double section and 6 ft. per day in the single or upper section. Sectional moulds were used and the work was handled from the inside by means of a scaffolding built up with the chimney."

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; C. S. Embrey, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wisconsin.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Haydite Manufacturers' Association; Dan F. Servey, Secretary-Treasurer, 203 Mutual Building, Kansas City, Mo.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Association of Paris Transit Mixed Concrete Manufacturers; Chas. P. Maloney, Secretary, E. Water and E. Salmon Streets, Portland, Oregon.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; Headquarters, 27 Barbeau Street, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wisconsin.

New Equipment and Materials

2-A Portable Electric Handsaw New Wappat Product

The new Wappat 2-A portable electric handsaw, cutting capacity 2⅝ in., embodies many features, the manufacturer states, among them its ability to cut through full 2 in. lumber.

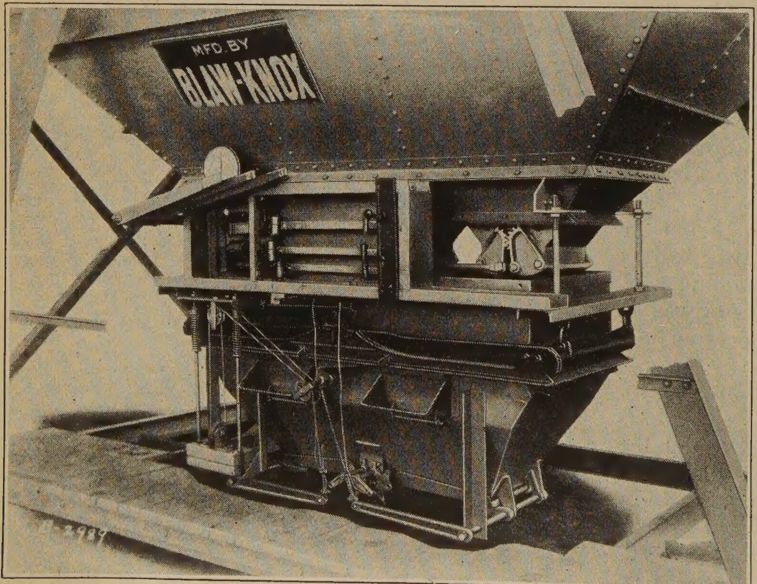
Another feature is the momentary type switch with the safety lock. The button at the operator's thumb must be depressed before the trigger will act. This "foolproof" switch makes it impossible for the saw to be accidentally started. The full-grip trigger, a new feature in handsaws, takes strain off the index finger.

Additional features include a non-shatter glass dust-shield, making it possible for the operator to follow a line with full vision. A rip fence located on the forward part increases the efficiency when making rip cuts.

The Wappat Gear Works, Pittsburgh, Pa., is the manufacturer.

Triple Weighing Batcher

Blaw-Knox Company, Pittsburgh, Pa., presents its latest improved type of triple weighing batcher for three-compartment bins. As shown below, a notable feature is the new clam-shell gate for each compartment, with easy lever arrangement for quick operation and accurate control.



New 2000 Pound Ingersoll-Rand Air Hoist

Ingersoll-Rand Company, New York City, has introduced a new-sized "Utility" portable air hoist of 2000 lb. capacity.

"Utility" Hoists, in capacities up to 1500 lbs., have been used by contractors for the past three years.

The "Utility" employs a radial, four-cylinder, counterbalanced, reciprocating-piston-type air motor, which is reversible. All wearing parts and cylinders are easily renewable, and the cylinders are also interchangeable, according to the manufacturer.

Industrial Literature

Cinder Units News

The second issue of *"The National Building Units News"* for June, contains several interesting articles and brief items on Straub cinder units, interestingly prepared and presented.

Among these are "Servicing Large Jobs" and "The Cinder Unit in Reading." Several excellent illustrations of jobs are reproduced.

The "News" is published monthly by the *National Building Units Corporation*, Philadelphia, Pa.

Standard Bar Size Cards

The Concrete Reinforcing Steel Institute, Chicago, Illinois, is distributing a substantial bar card showing the eleven standard sizes of bars and the weights adopted as standard at its meeting in the spring. They are to be put into effect at once. While they do not represent the actual weights of any type of bar they are equitable average weights for all types.

Biehl Ready-Mixed Unit

The Biehl ready-mixed concrete conveyor and its operation are described in a 4-page folder showing the unit in transit and unloading, and in cross section line drawings.

These conveyors are sold mounted on any suitable body, it is stated. Also, they are powered by a separate motor which can be operated at a uniform speed, in addition to having a governor control to allow running the motor at the most suitable speed according to the length of haul. *The Biehl Iron Works, Inc.*, Reading, Pa., manufactures the conveyor.

N. E. C. Pictorial Catalogue

The service the *National Equipment Corporation*, Milwaukee, Wis., is able to render the contractor through the unified efforts of its six divisions is the object of its *Pictorial Catalogue*, just off the press.

The organization is comprised of the Koehring, Smith, C. H. & E., Insley, Parsons, and Kwik-Mix divisions and several units of equipment of each of these are briefly described as to application and shown in use on jobs.

Flower Pot Machine Folder

Complete information on the *Bewley* Duplex flower pot machine is contained in a 4-page folder just completed by the *Portland Concrete Machines Company*, Chicago. The latter are the exclusive sales agents east of the Rocky Mountains.

The machine is designed to produce all sizes from 2 to 12 inches in diameter. Information on capacity, costs, and forms is included.

F & J Engines

The contents of a recent issue of *"Power News,"* published by the *Fuller & Johnson Manufacturing Company*, Madison, Wis., include brief descriptions of two concrete jobs employing mixers powered by Fuller & Johnson engines.

Another publication of interest is *Catalog* 930, on B & D electric tools, on which Fuller & Johnson can furnish complete information. Units cataloged include drills, hammers, saws and grinders.

Incor Bridge Slabs

The first page of a 4-page leaflet issued by the *International Cement Corporation*, New York City, during June, illustrates the placing of concrete slabs on a Chicago bridge and tells how Incor permitted their casting and form stripping the same day.